EMBER, 1958

ents, page 318

RUBBER WORLD

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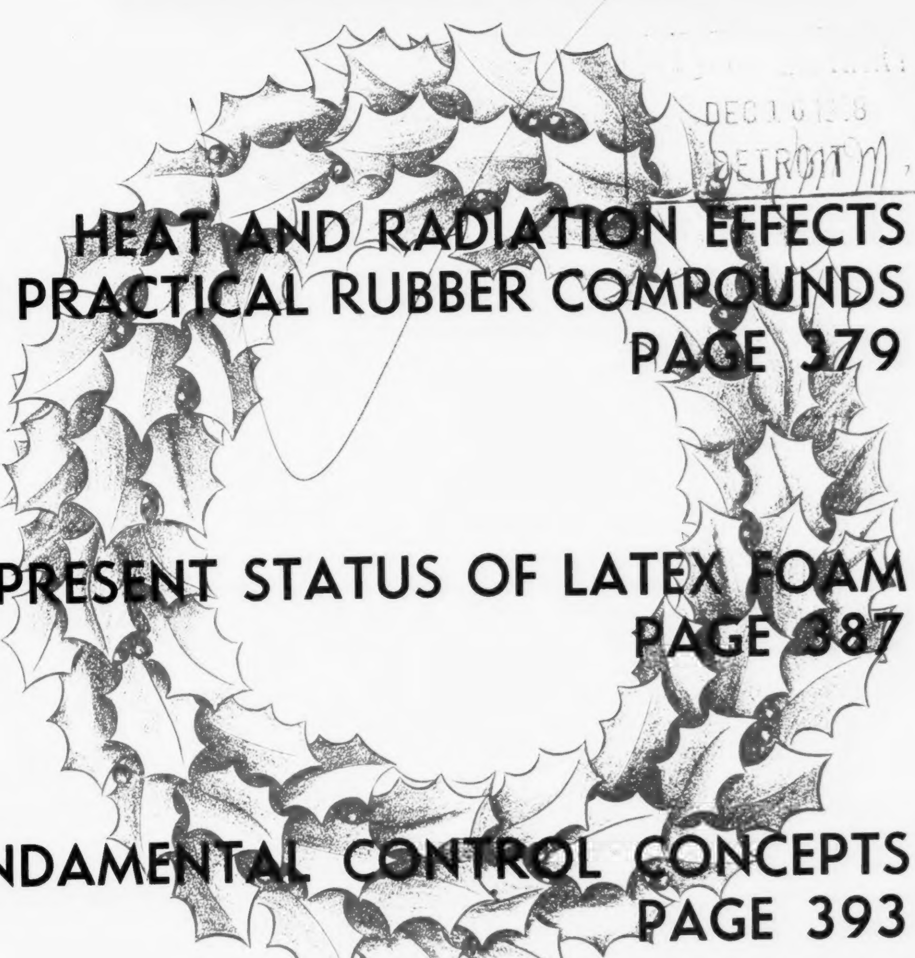

HEAT AND RADIATION EFFECTS ON PRACTICAL RUBBER COMPOUNDS
PAGE 379

PRESENT STATUS OF LATEX FOAM
PAGE 387

FUNDAMENTAL CONTROL CONCEPTS
PAGE 393

FIFTH JOINT ARMY-NAVY-AIR FORCE ELASTOMER RESEARCH CONFERENCE

RMA INDUSTRY PERFORMANCE, BUSINESS AND LEGISLATIVE OUTLOOK

BILL BROTHERS
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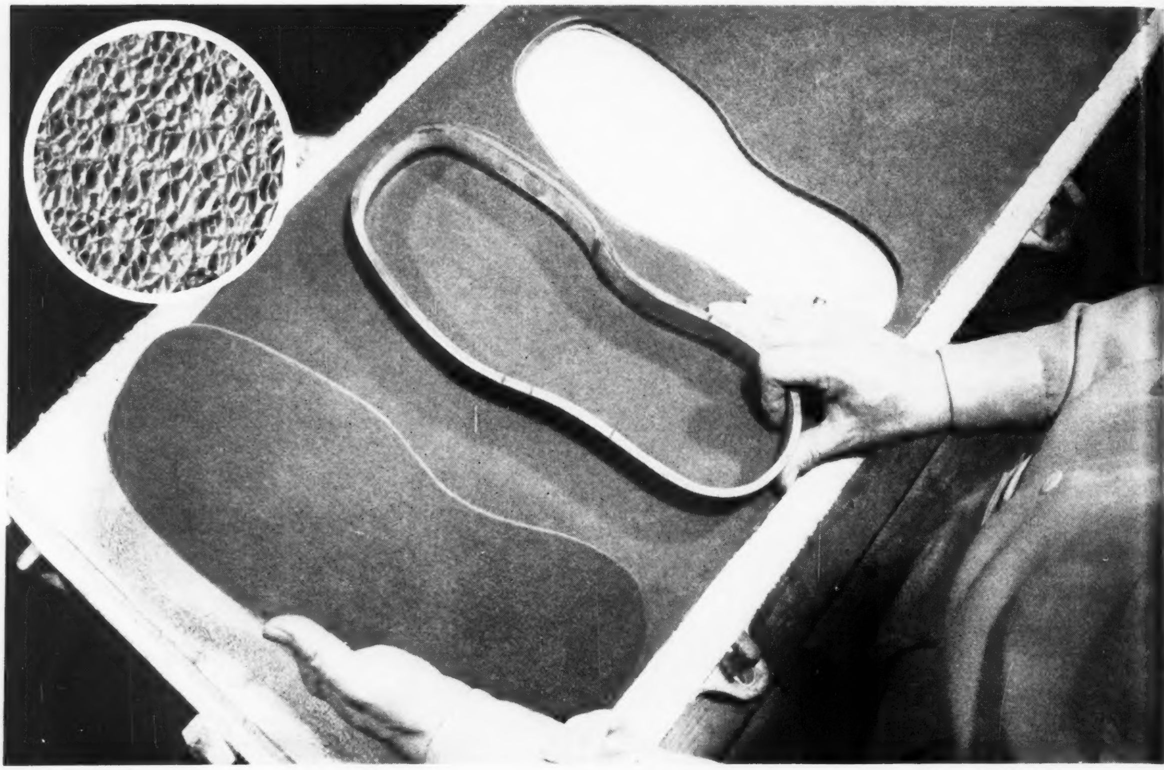

Uniform cell structure for quality cushion shoe soles...with Du Pont UNICEL ND

Whether it's a closed cell shoe sole or an open cell bathroom sponge, there's a dependable Du Pont blowing agent that will assure uniform cell structure in the elastomeric sponge you make.

UNICEL ND, 40% N, N-dinitrosopentamethylenetetramine . . . for open or closed cell sponge products.

UNICEL NDX, 80% N, N-dinitrosopentamethylenetetramine . . . where higher active ingredient content is desired in making open or closed cell sponge.

UNICEL S, a fine dispersion of sodium bicarbonate in light mineral oil . . . for open cell sponge products.

Each member of this family of Du Pont blowing agents disperses readily in all elastomers. Each is non-discoloring, non-blooming, non-toxic, possesses excellent storage stability and, in addition, is most economically attractive.

UNICEL ND and UNICEL NDX produce small, uniform cells in either open or closed cell sponge. Effective odor control can be obtained by the addition of 25% urea and 15-25% Aquarex NS based on the amount of blowing agent used.

UNICEL S, for open cell sponge, disperses quickly and decomposes much more rapidly and completely than ordinary sodium bicarbonate, permitting the use of smaller amounts of blowing agent. It produces odor-free sponge.

For more information about these Du Pont blowing agents, write for Report 56-3 or contact the district office nearest you.

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RUBBER WORLD

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VOLUME 139, NUMBER 3 DECEMBER, 1958

CONTENTS

The opinions expressed by our contributors do not necessarily reflect those of our editors

FEATURE DEPARTMENTS

Merry Christmas and Happy New Year

from the Philblacks* and the Philprenes*

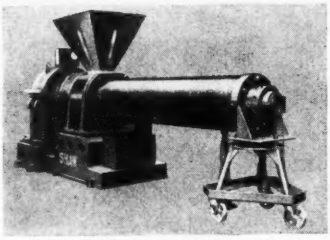
*(A trademark)

FRANCIS SHAW

quality engineering puts efficiency into Shaw machines

The cost-cutting performance of every Francis Shaw machine and its thorough dependability are the result of long experience and unvarying high standards of engineering in every detail of manufacture.

Close-limit accuracy and rigorous inspection during manufacture guarantee to the user a consistently high quality output from Francis Shaw equipment.



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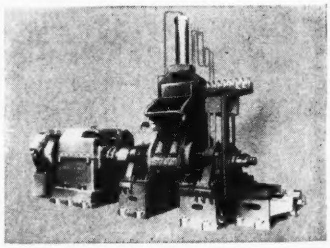

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TELEPHONE NELSON 4-2350 TELEGRAMS CALENDER BURLINGTON ONTARIO

P.1160

How ounces of rubber can harness herds of horses

Keeping the herds of horses harnessed in today's aircraft engines "on the go" often depends upon a few ounces of rubber. In the form of "O"-rings, frequently no bigger than a pencil eraser, this rubber serves as a packing on actuating cylinders, selector valves and other vital parts where positive sealing is essential.

It used to be that "O"-ring failures were all too frequent. Ordinary rubber could not withstand the various hydraulic fluids, the –40°F. to 160°F. temperatures, the flexing, the stretching, the elongation. But the picture changed when Goodyear introduced CHEMIGUM—first of the truly oil-resistant rubbers.

The unique composition of CHEMIGUM soon made possible "O"-rings with an absolute minimum of swell or shrinkage, excellent resistance to heat and cold, very low compression set and maximum squeeze combined with minimum friction. And its easy processing permitted meeting tolerances in the very low thousandths of an inch.

Perhaps the fate of your product also can be assured a success by CHEMIGUM. For full details plus the finest in technical service, just write to

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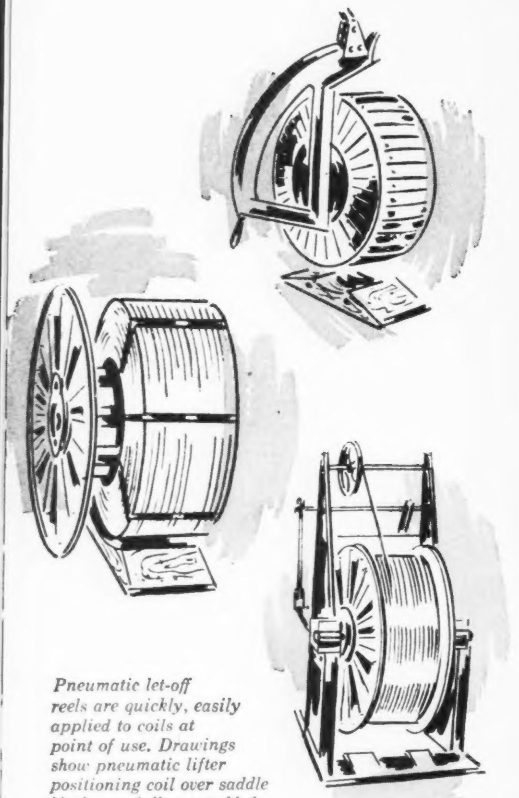
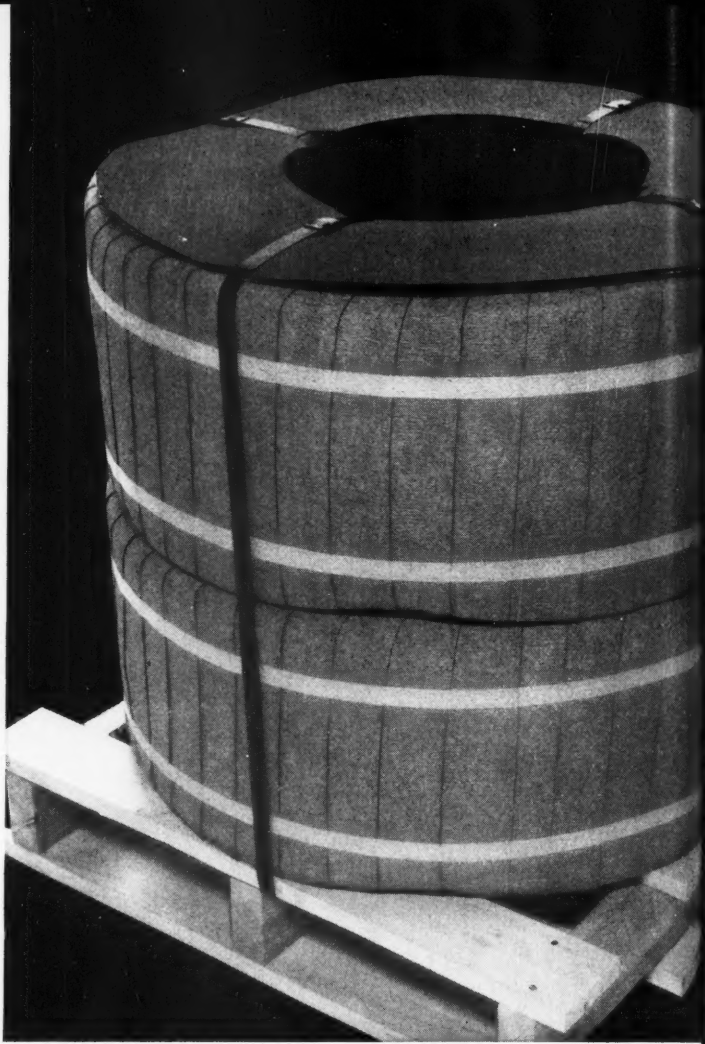


Pneumatic let-off reels are quickly, easily applied to coils at point of use. Drawings show pneumatic lifter positioning coil over saddle block, partially assembled reel and completely assembled reel feeding wire from conventional let-off stand.



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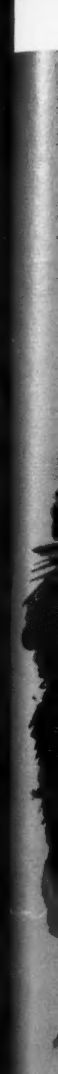
WORCESTER WIRE WORKS, Worcester, Mass.; *music spring, stainless and plated wires, high and low carbon specialties* • **REYNOLDS WIRE, Dixon, Ill.;** *industrial wire cloth*
WAGNER LITHO MACHINERY, Secaucus, N. J.; *metal decorating equipment* • **ATHENIA STEEL, Clifton, N. J.;** *flat, high carbon spring steels*
CROSS PERFORATED METALS, Carbondale, Pa.; *industrial, commercial, and decorative perforated metals*


CIRCA 1916



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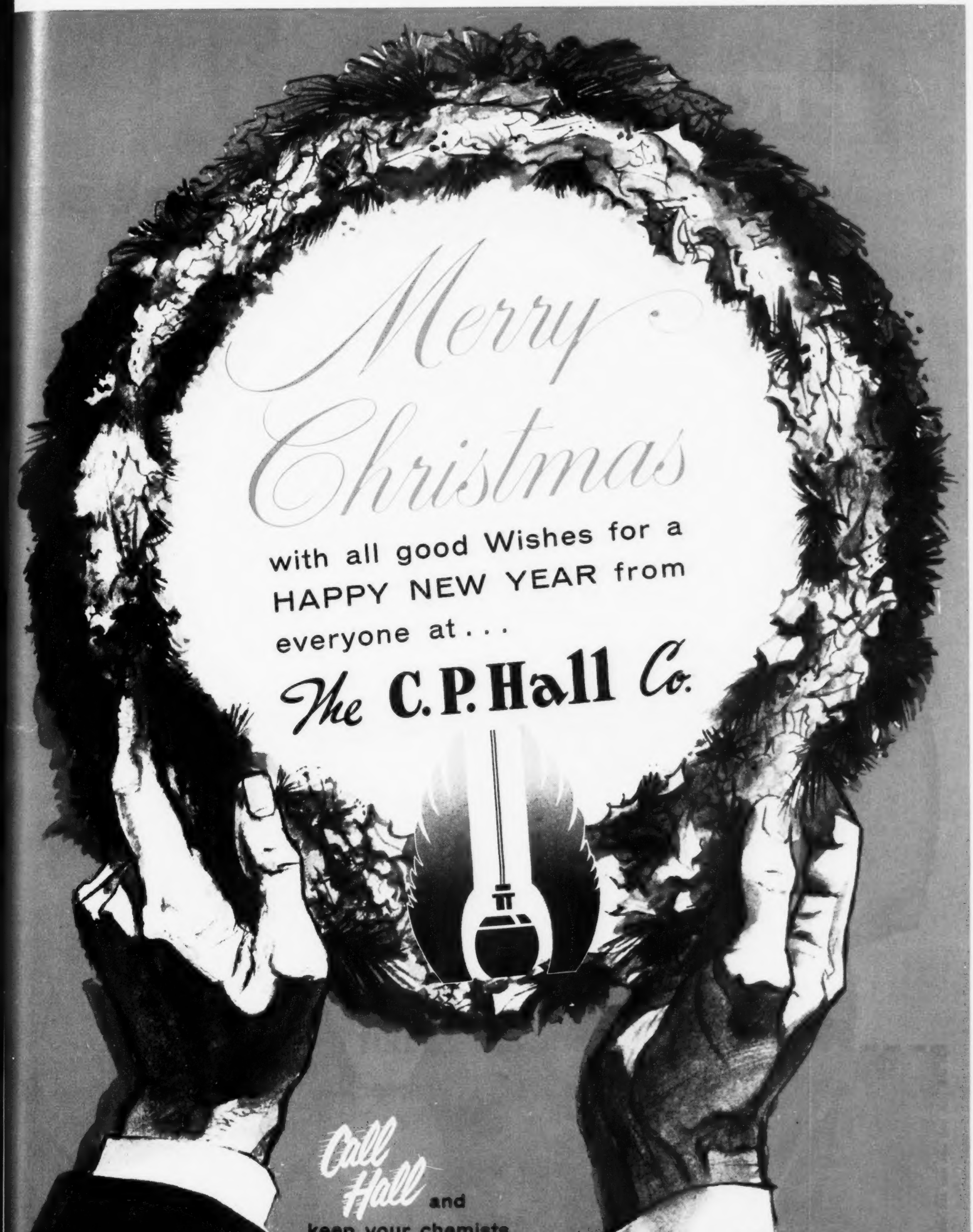
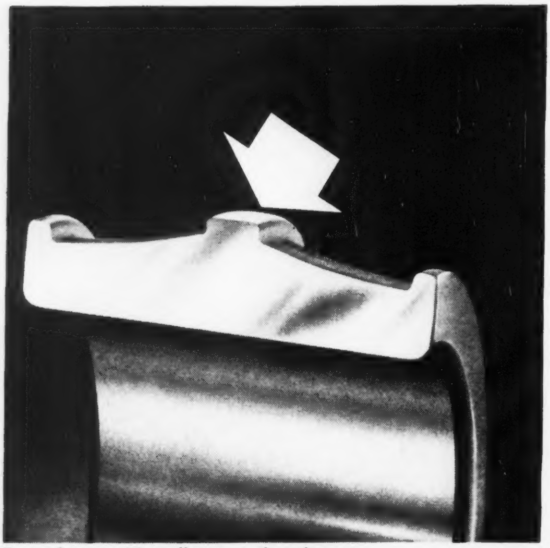
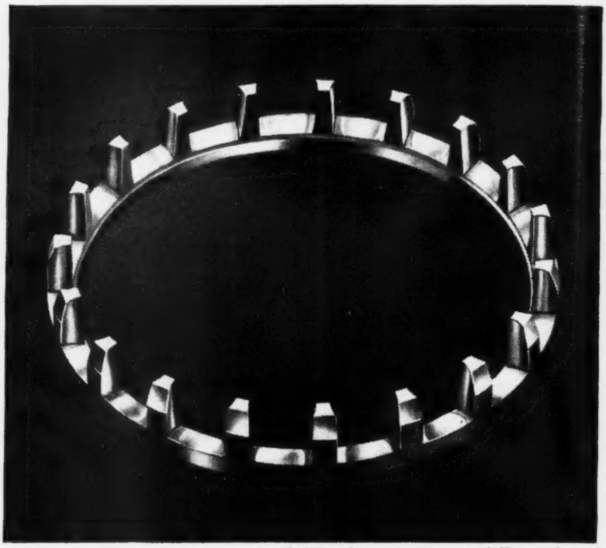

Merry Christmas
with all good Wishes for a
HAPPY NEW YEAR from
everyone at . . .
The C.P. Hall Co.
Call Hall and
keep your chemists
and compounders in
Christmas mood
all year long . . . with
the best in chemicals

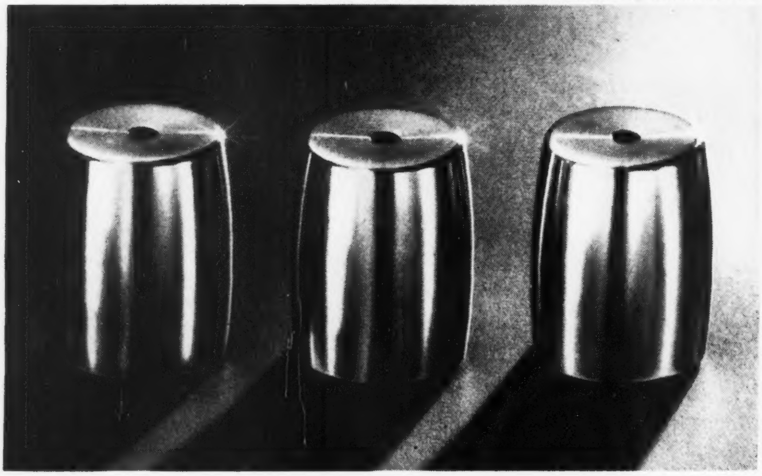


Center flange guides rollers to peak performance.



Land-riding bronze cages are fully machined.

Roller diameters are matched electronically within .0001".



NEW IDEA LAB

FOR RUBBER & PLASTIC

• This Process Laboratory in Akron, Ohio is a birthplace of new ideas in rubber and plastic. Here we develop basic machines, such as automatically operated mills and processing screw extruders to:

1. **Produce more products per man-hour.**
2. **Produce products of higher quality.**
3. **Produce products with new and different material formulations.**
4. **Produce new end products.**

New materials, new processes and new products require new machines and new thinking. Wherever your horizons lead you, this Laboratory could possibly supply some of the answers. Your new idea or idea yet to be born can mature here. Outline your thinking by phone or letter and we will go to work.

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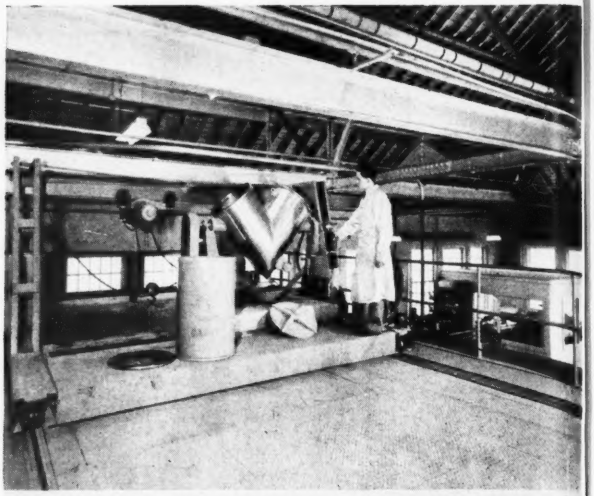
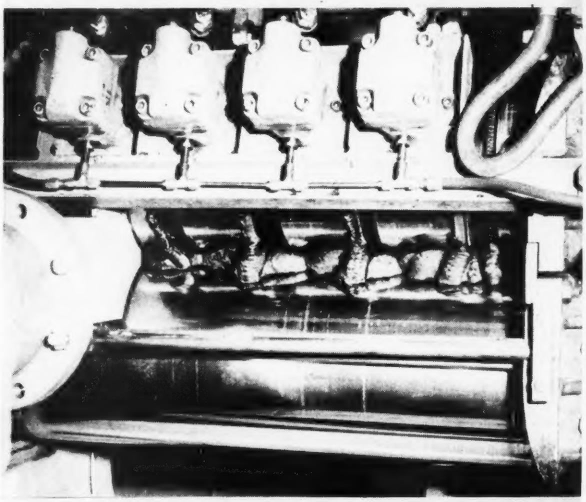
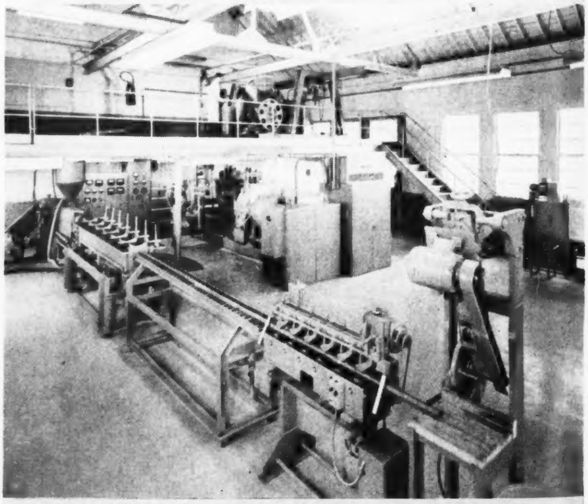


Raw material handling may include blending, automatic weighing, and controlled feeding.



The Continuous Automatic Mill dispenses pigments and plasticizes uniformly without manual attention.



We specialize in screw machines for processing, blending, reclaiming, or devolatilizing.

PROGRESS UNDER PRESSURE–Typical of Southern Railway's emphasis on progress, safety and modernization is a unique, four-mile compressor system installed in its yards in Birmingham, Alabama. Air hoses similar to the one shown are spaced at 1000 ft. intervals and are fed by means of a 4" pipe from a central compressor reservoir. When three or more of these hose extensions are hooked up to a freight train, the necessary air pressure can be built up in much less time than by charging with pressure generated from the locomotive. Another important advantage to this independent source of air pressure is that it permits the discovery and repair of line leaks before the engine is coupled to the train, thus minimizing the possibility of expensive delays. The hose used for this air pressure system was supplied by Carolina Rubber Hose Company and made from Mount Vernon duck.

This is another example of how fabrics made by Mount Vernon Mills, Inc. and the industries they serve, are serving America. Mount Vernon engineers and its laboratory facilities are available to help you in the development of any new fabric or in the application of those already available.

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In our Josephtown laboratories, two lots of secondary zinc oxide from the *SAME* supplier analyzed as follows:

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PbO	.04	.11
Total Sulfur	.15	.32
Gritty Particles:		
(Silica, Dust, Dirt, Metallics)	Present	Present

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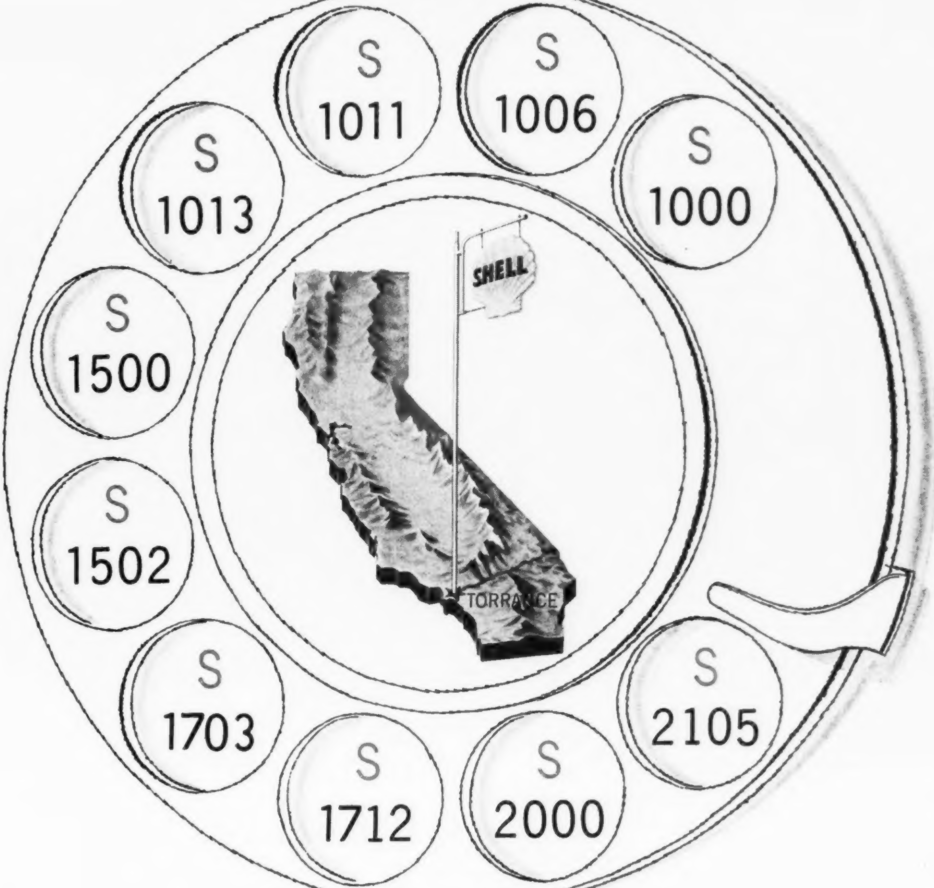

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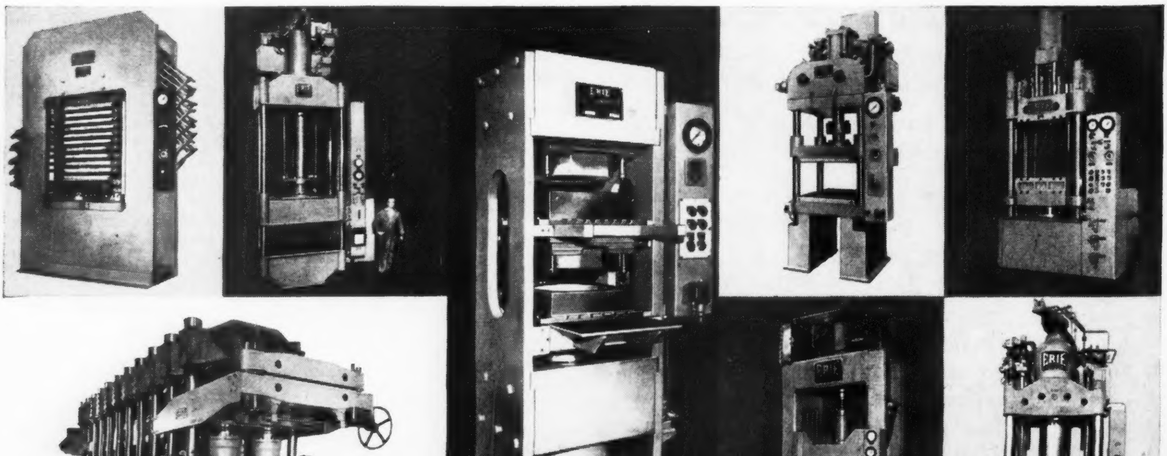

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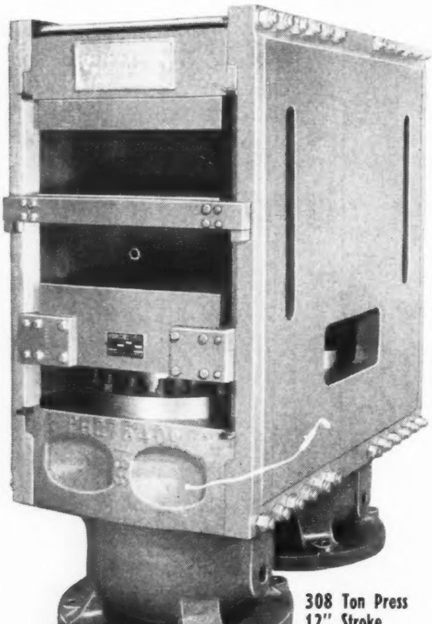

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Further details are easily obtained by writing to:

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INSTITUTION OF THE RUBBER INDUSTRY
4, KENSINGTON PALACE GARDENS
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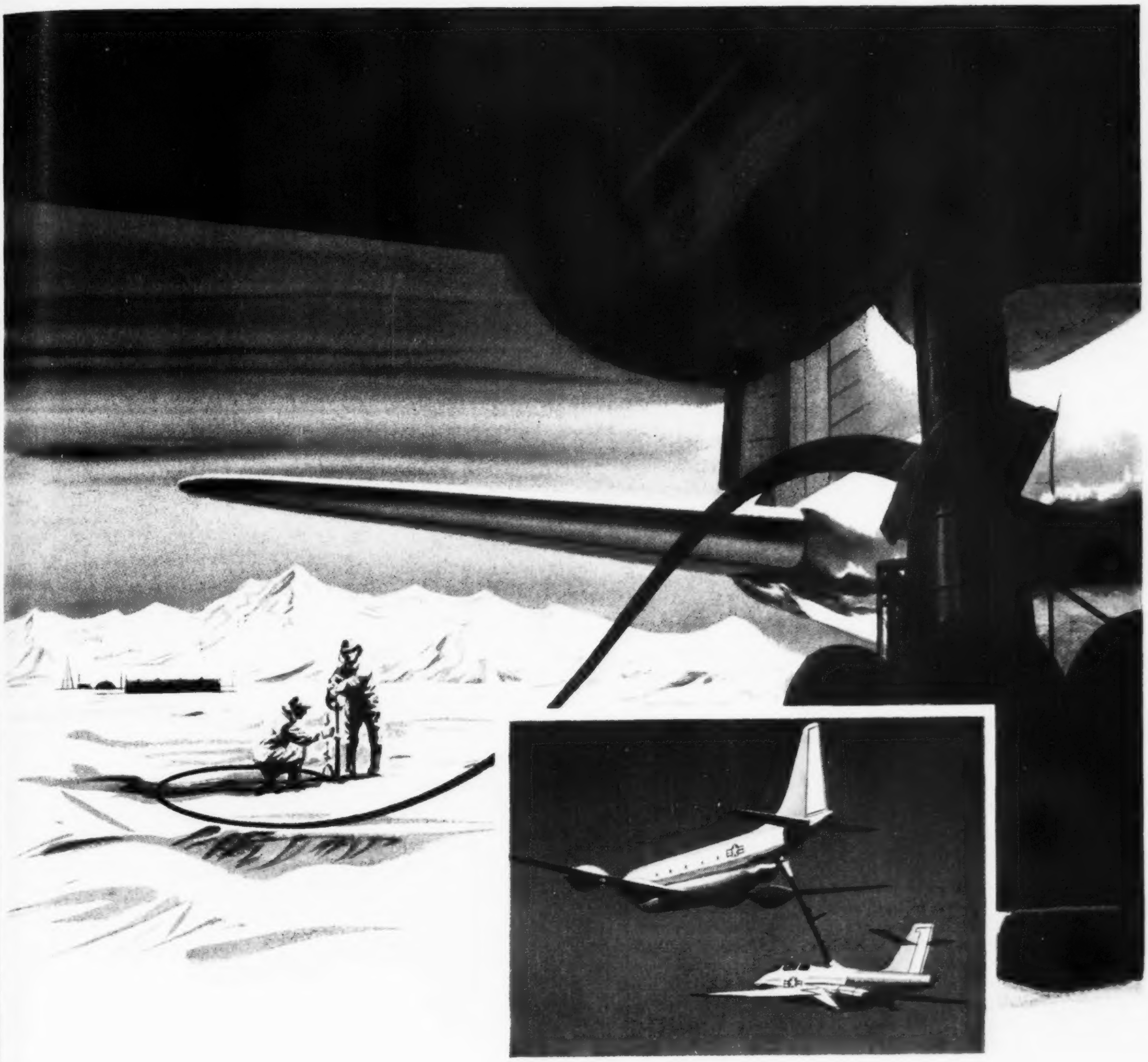
Telephone: Bayswater 9101



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. . . it takes unique rubber hose to keep flexible in such extremes of cold.

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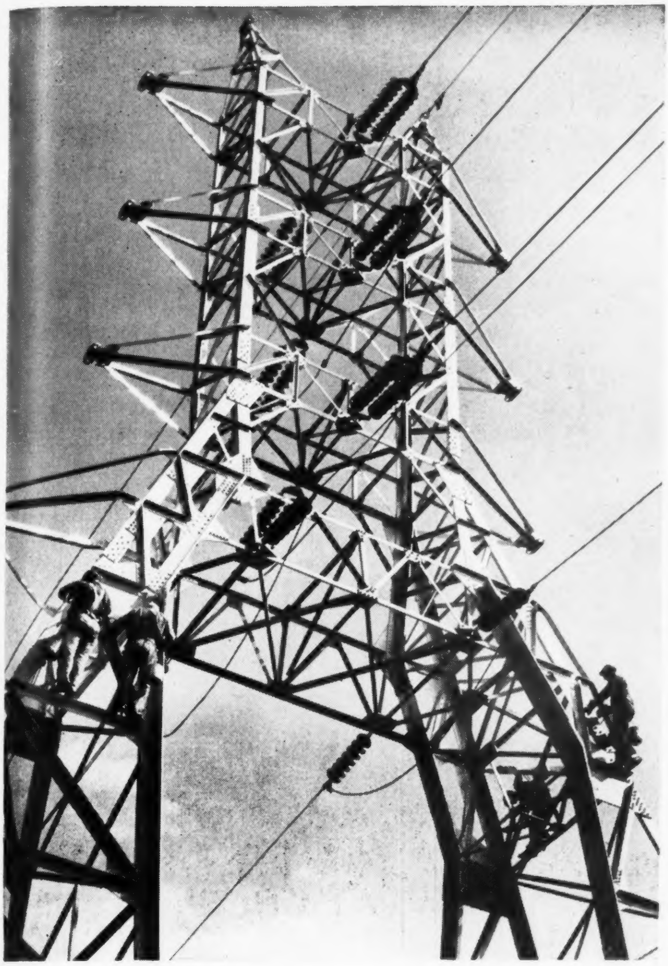

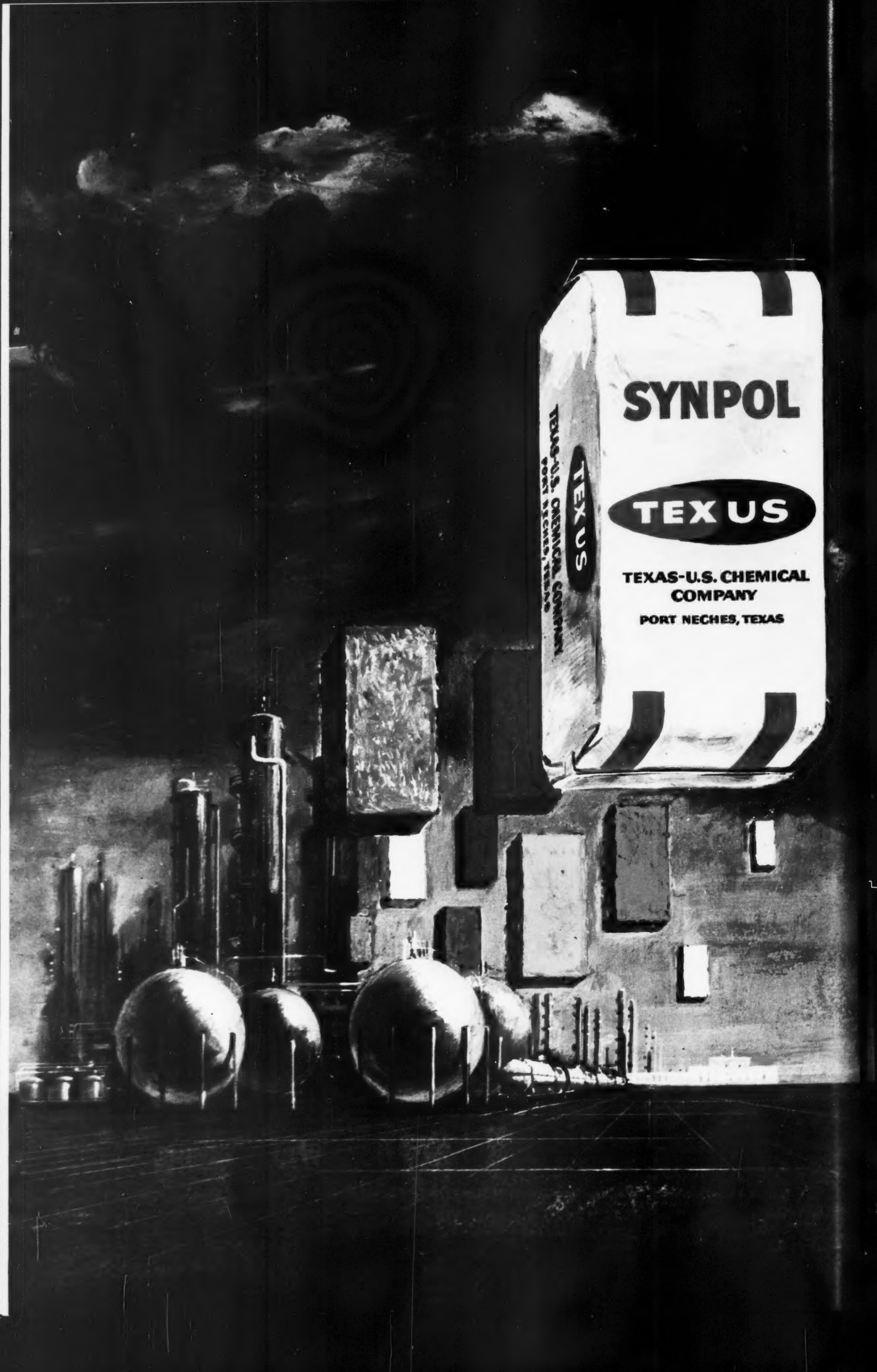
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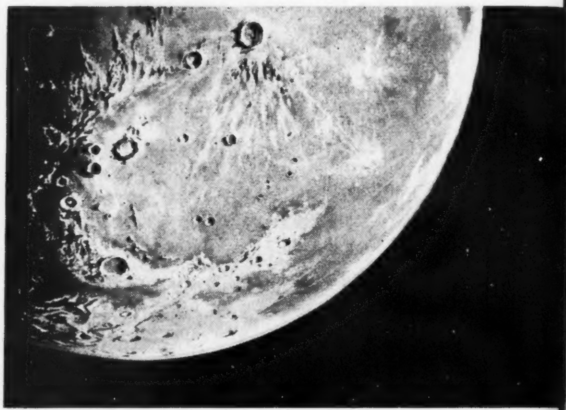

dry . . . . . drier . . . . . DRIEST

DRYNESS in all the above examples stems from lack of moisture in the surrounding environment. Naugapol® styrene-butadiene rubber, on the other hand, is dry—and stays dry—*in spite* of surrounding moisture!

That's because we specially process all eight types* of Naugapol polymers to eliminate moisture-absorbing salts. Acid is used in place of salt as the coagulant following polymerization, and extra straining and milling further remove water solubles. As a result these premium grades of rubber are noted for their:

- **HIGH DIELECTRIC PROPERTIES**
- **LOW ASH CONTENT**
- **EASY PROCESSING**

These properties make Naugapol polymers ideal for use in the extruding of wire and cable insulation and the manufacture of mechanical rubber goods where low moisture absorption properties are required. For more details on these and other special grades of synthetic rubber, write us about your requirements.

*Naugapols are made in types 1016, 1018, 1019, 1021, 1022, 1023, 1503 and 1504.

Naugatuck Chemical

1220N ELM STREET

Division of United States Rubber Company, Naugatuck, Connecticut

US RUBBER

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Naugatuck PARACRIL OZO

The oil-resistant, ozone-resistant nitrile rubber

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Two pairs of shoes were used in this test, each pair worn every other day to provide similar test conditions. The first pair, with good quality conventional soles, became unfit for use in a little over six weeks' time. Yet the shoes with PARACRIL OZO soles—despite the kicks, scrapes, grinds, and special kind of abuse for which little boys are known—showed only a fraction of the wear. At the end of the test they were still good for months.

Take a tip from the tot. Insist on PARACRIL OZO soles for the shoes *you* sell. It makes a major selling difference. To learn more about PARACRIL OZO, write the address below. Names of sole manufacturers on request.

Naugatuck Chemical

Division of United States Rubber Company 1220P Elm Street Naugatuck, Connecticut

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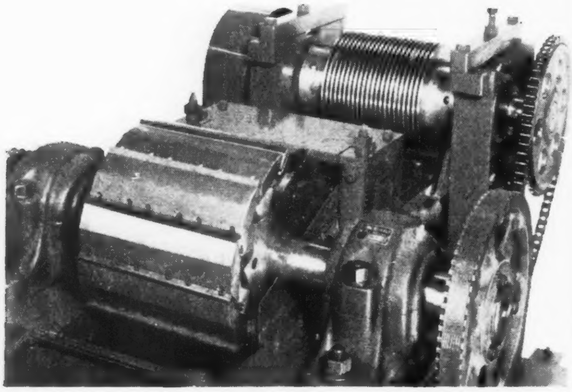

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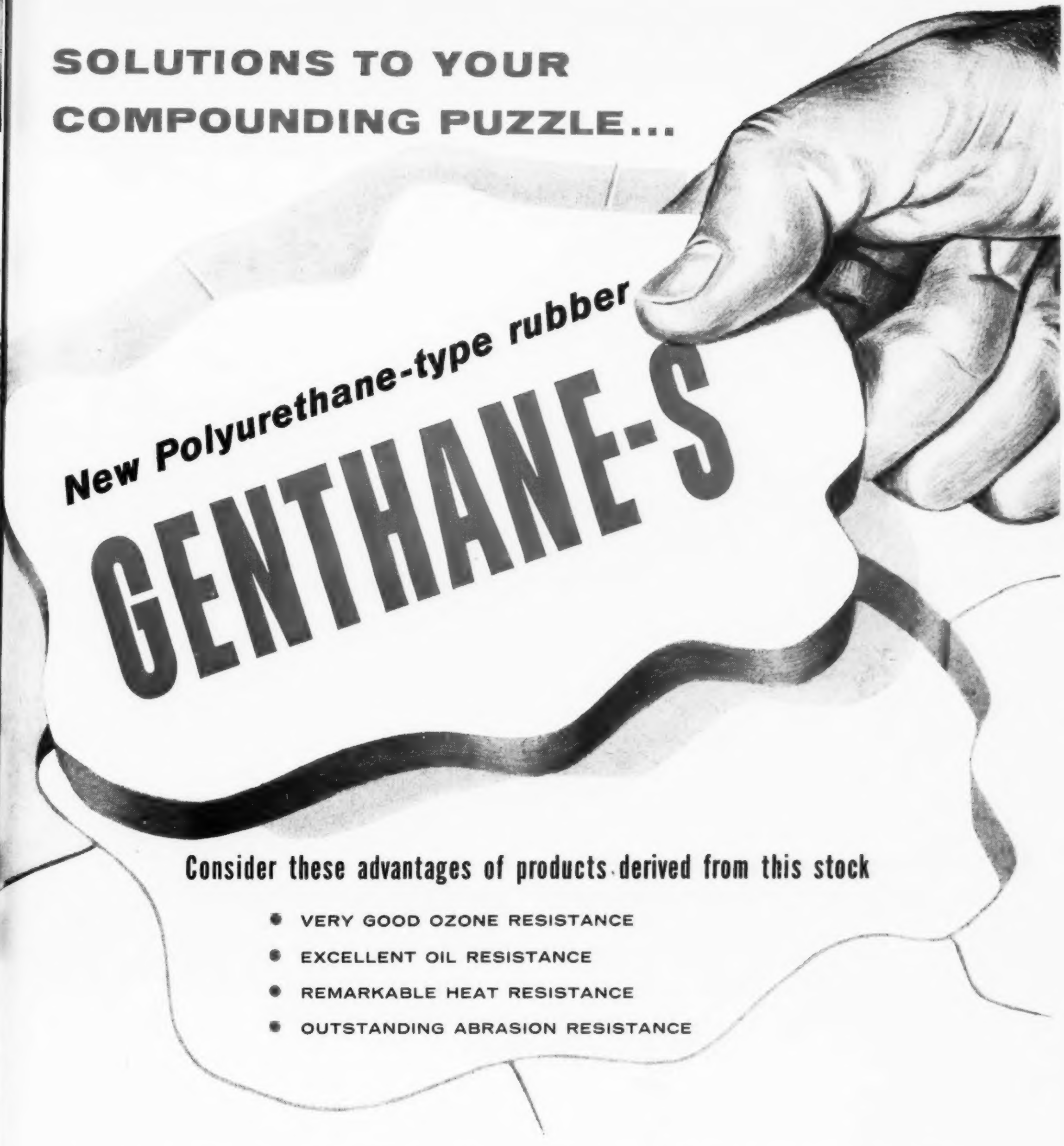

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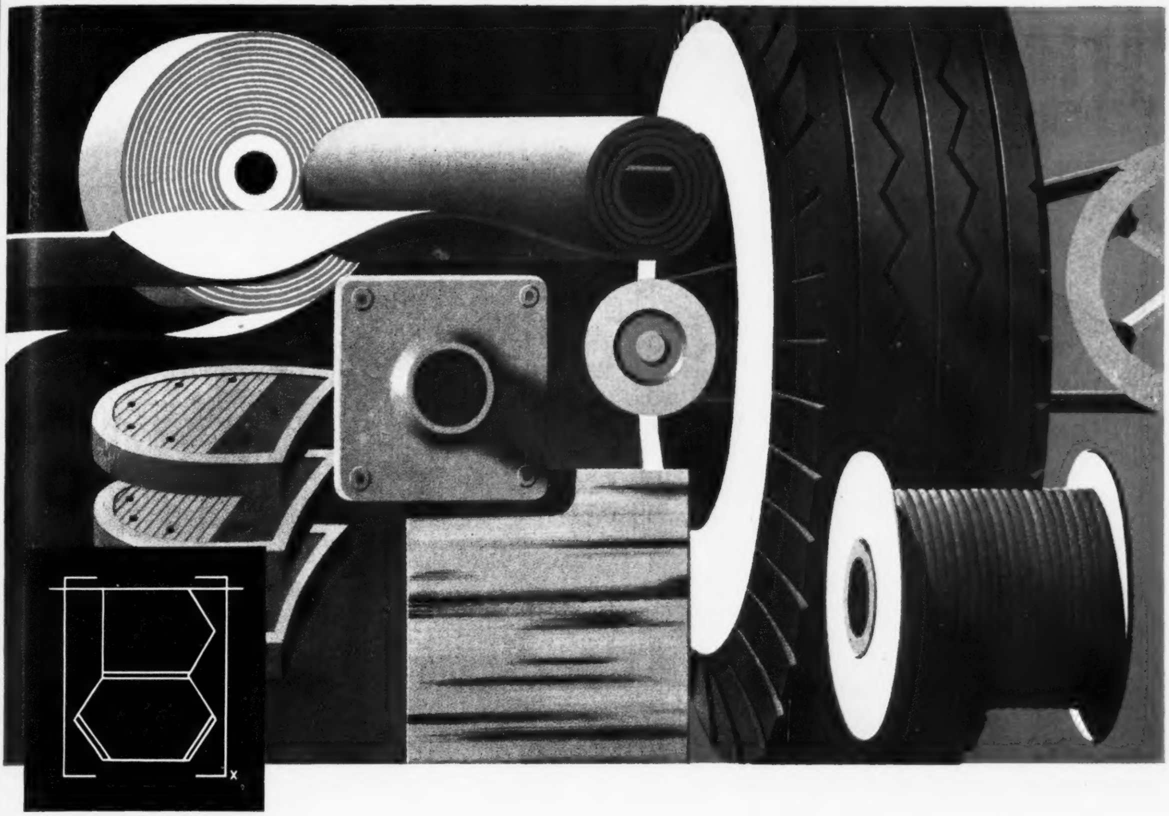

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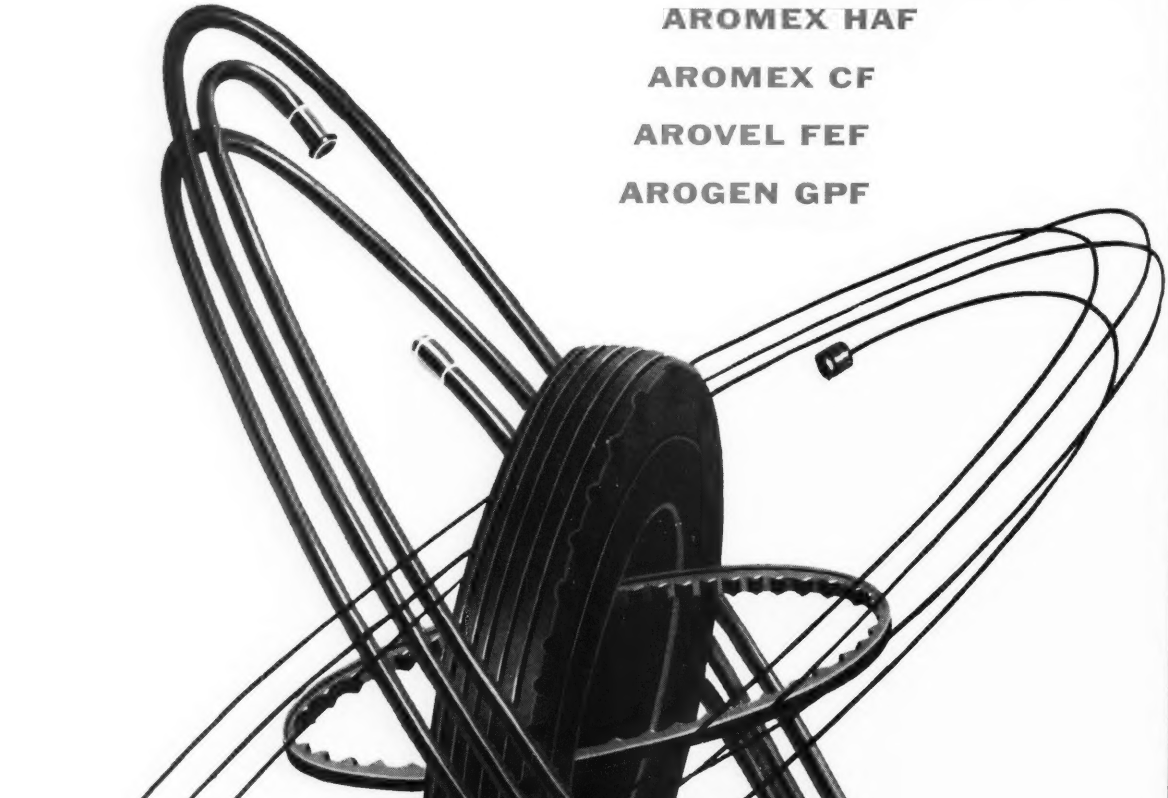

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RUBBER WORLD
EDITORIAL

An Attempt To Help SBR Producers Help Themselves

A SITUATION has developed in the field of marketing styrene-butadiene rubbers which could result in a disservice not only to the producers themselves, but to their customers. The difficulty involves, in part, the system of numbering SBR polymers, particularly those in the so-called experimental or semi-commercial class. We called attention to the possibility of chaos in the marketplace that might develop if the system of numbering such polymers available in the June, 1956, Tentative Recommended Practices for Description of Styrene-Butadiene Rubbers, ASTM D 1419-56T, of the American Society for Testing Materials was not followed, in this column in July of this year.

Of equal and conceivably even greater importance is the fact that whether the SBR producers follow the ASTM numbering system or not, there are now at least 60 or more of these semi-commercial polymers available, and details on composition and prices for many of them have not been made available to Rubber World or the consuming public generally.

For example, how many of the readers of this column know the composition and price of Shell Chemical's S-7750, Philprene 6604, Ameripol 4651, General Tire's 9275, or United Carbon's B-127?

Although the total annual tonnage of these semi-commercial SBRs may not amount to more than 50,000, this is a most important tonnage. It represents the new materials the producers have been asked to make or have decided to offer based on their estimation of future demand, and it also represents the broadened spectrum of SBR polymers now available to the 1,500 companies and more than 1,800 plants of the rubber products industry.

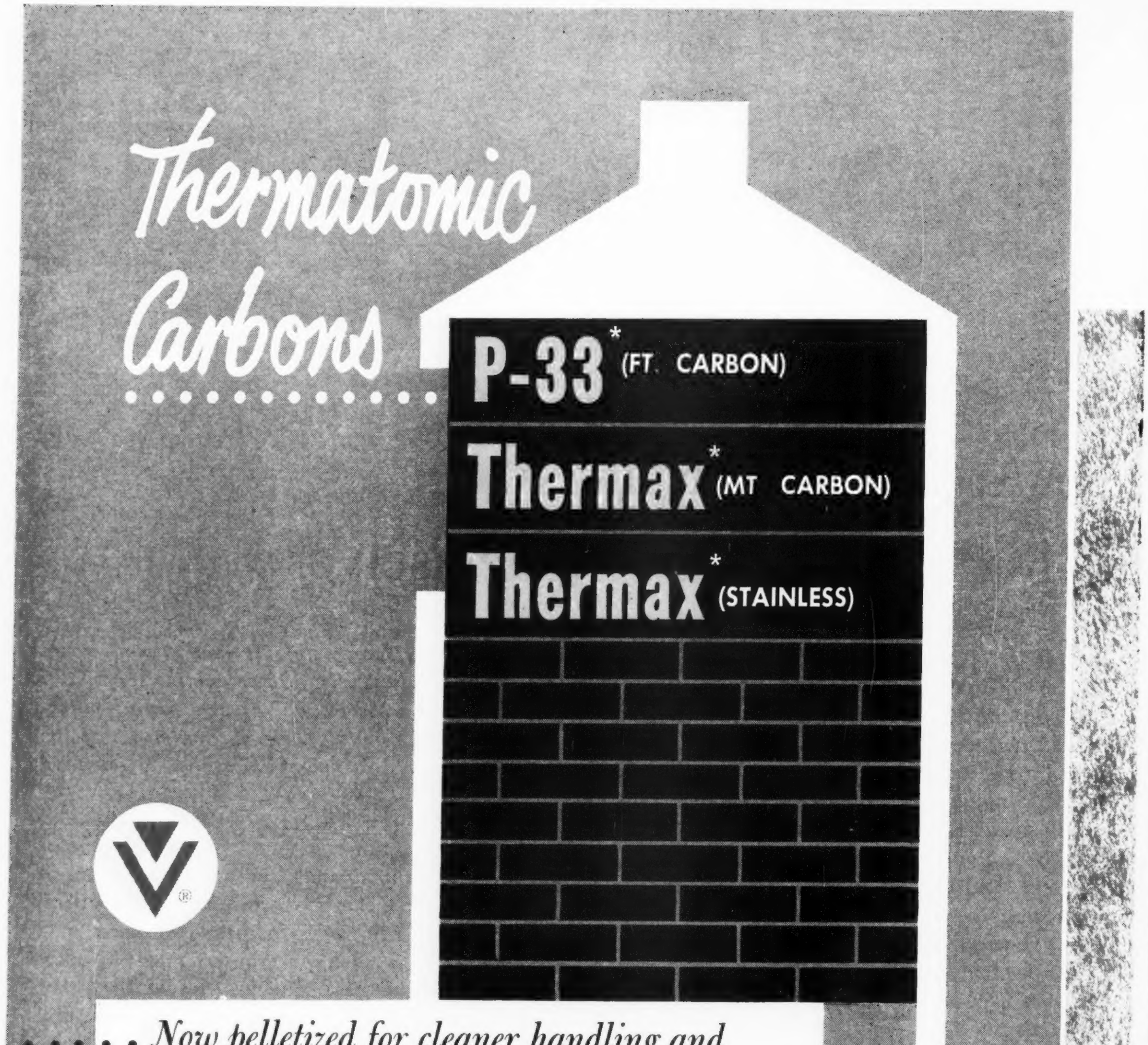
If more or less complete information and prices are not available to all on these polymers, how can the producers achieve their greatest market potential and the consumers their maximum use of the best available SBR materials, which is one and the same thing?

The primary aim of Rubber World is to be of service to the rubber and supplier industries, but in order to achieve this aim we must have cooperation from the companies in these industries. Such cooperation has been generously given in most instances in the past, but has developed rather slowly with the SBR producer branch, possibly because of the newness of this branch and the very rapid pace of its growth.

If the SBR producers will forward all available information on composition and prices of their semi-commercial SBRs, a table showing the number, composition, and prices will be developed and published for the mutual benefit of all concerned. This table will be in addition to the one published every other month for the standard SBR polymers. In order to be sure that no producer is uninformed of this request, letters will be forwarded to every SBR producer with a copy of this editorial.

May we have the full cooperation of the SBR producers in this matter? The results should be of no small consequence to this country's producers and consumers of SBR.

R. G. Seaman
EDITOR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RUBBER WORLD

Combined Heat and Radiation Effects On Practical Rubber Compounds[1]

By J. W. BORN, E. E. MOONEY, and S. T. SEMEGEN
B. F. Goodrich Co. Research Center, Brecksville, O.

PRACTICAL rubber compounds are defined here as the factory-type rubber stocks which are used in the construction of a commercial product or end-item. The research to be described was aimed at measuring and improving the resistance of such compounds to damage by nuclear radiation. Radiation damage refers to the deterioration in physical properties which results from irradiation. The interest centered on four major aircraft rubber products: namely, hose, seals, fuel cells, and wire insulation. Prior research[2] had made it both feasible and desirable to conduct a separate end-item study of aircraft tires, which is reported elsewhere.[3]

End-items frequently contain several different rubber compounds, each of which has its own resistance to radiation damage. Specifications for rubber products are subject to change as experimental aircraft undergo development. It is therefore essential to know the individual radiation resistances of the various types of rubber compounds which may be combined to produce a future end-item.

Other environmental factors can influence the resistance of a rubber material to deterioration during nuclear irradiation. These include heat and oxygen, ozone, fuels, lubricants, and hydraulic fluids, any of which may be in contact with the rubber. Of these, heat is, in general, of most immediate and serious concern, particularly in aircraft rubber applications.

These considerations largely defined this study. Since heat and nuclear radiation would combine in various degrees which cannot now be accurately predicted, both separate and combined effects required measurement.

Basically, four questions about the resistance of practical rubber compounds to deterioration at elevated temperatures during irradiation needed to be answered.

TABLE 1. PRACTICAL RUBBER COMPOUNDS USED

Compound 81 GH-	Compound Identity: Elastomer	Use
311, 317, 318	neoprene	wire insulation
313, 327, 328	SBR	wire insulation
357, 359, 360	neoprene	packing compound
358, 365, 366	Hycar (NBR)	packing compound
386, 391, 393	Hycar-PVC Resin	fuel cell bladder
387, 395, 397	Hycar (NBR)	self-sealing cell liner
420, 423, 425	Hycar-SBR	hose compound
421, 427, 429	neoprene	hose compound

The detailed recipes of these 24 compounds appear in WADC Technical Report 55-58 Part IV (2). Wright Air Development Center Air Research & Development Command, USAF, Wright-Patterson Air Force Base, Ohio.

First, how does the degree of deterioration vary with radiation dose at a given temperature? Second, how does raising the temperature affect the deterioration which rubber undergoes during a given radiation exposure? Third, do heat and radiation interact by simple addition of their separate effects, or is the interaction synergistic? Finally, do potential anti-rads protect such practical compounds from radiation damage? This paper describes the initial phases of the research which was formulated to answer these questions.

[1]Presented before the Division of Rubber Chemistry, ACS, Cincinnati, O., May 15, 1958. The work was performed under U. S. Air Force contract; the sponsoring agency was the Materials Laboratory of Wright Air Development Center.

[2]J. W. Born, D. E. Diller, and E. H. Rowe, "A Study of the Effects of Nuclear Radiations on Elastomeric Compounds and Compounding Materials," WADC Technical Report 55-58, Part III, B. F. Goodrich Co. Research Center, Dec., 1956.

[3]J. W. Born *et al.*, *Ibid.*, Part IV, B. F. Goodrich Co. Research Center, Feb., 1958.

Heat and Radiation Effects on Practical Rubber Compounds

This paper reports the initial results of a continuing study of the separate and combined effects of heat and gamma radiation on practical, factory-type rubber compounds. Two representative stocks were chosen from each of four major classes of aircraft products: namely, hose, seals, fuel cells, and wire insulation. Two recipe variations of each compound were also included, involving separate incorporation of two potential radiation damage inhibitors. The elastomers were styrene-butadiene, neoprene, and nitrile rubbers. Combinations of SBR and NBR and of NBR and polyvinyl chloride were also included.

Stress-strain and hardness measurements were employed to evaluate physical deterioration. The study involved gamma irradiations up to 1260 x 10^7 ergs per gram of carbon and physical testing at room temperature and 158° F. This work will involve four sets of test conditions, and that reported in this paper is the first phase of continuing research intended to involve temperatures of 212 and 280° F.

The importance of equivalent cure was emphasized. The principal changes resulted from radiation exposures ranging up to 850 x 10^7 ergs per gram of carbon at room temperature and 340 x 10^7 ergs per gram of carbon at 158° F. Based on the exposure required to reduce the initial ultimate elongation by one half, the additives appear to give greater protection during irradiation at room temperature than they do at 158° F.

Selection and Preparation of Samples

At the outset the question arose of which few recipes should be selected to represent the many practical compounds in aircraft rubber parts. With the help of Goodrich technical personnel in production, two representative compounds were chosen for each of four major classes of aircraft products: namely, hose, seals, fuel cells, and wire insulation. In selecting the compounds an effort was made to include (1) typical production compounds, (2) compounds of primary importance in end-items of complex construction, and (3) a variety of elastomers.

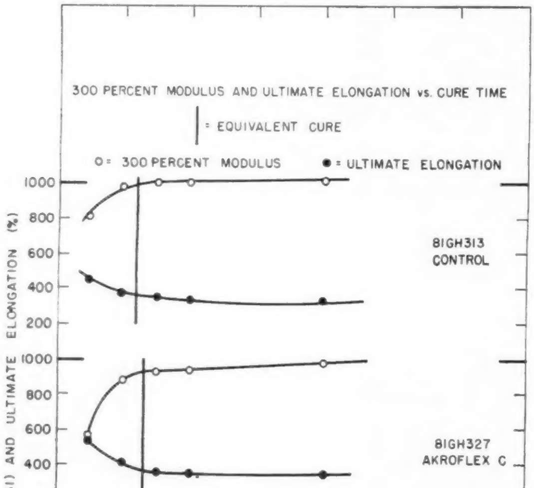

Fig. 1. Equivalent cures of SBR wire compounds

Six additives were selected from the best radiation damage inhibitors (anti-rads) for natural rubber as revealed by an extensive earlier survey.[2] Two of the six: namely, Akroflex C[4] (35% N, N′-diphenyl-para-phenylene diamine plus 65% phenyl-alpha-naphthyl amine) and quinhydrone, were chosen for use in this first of three phases in a continuing study. The standard additive concentration was five parts per hundred parts of elastomer (phr).

The compounds in Table 1 were selected to represent the above classes of practical rubber stocks for aircraft. The increasing numbers in each series of three correspond to the master compound without selected additive, with Akroflex C, and with quinhydrone, respectively.

The present research was concerned with aging, that is, the deterioration of physical properties with time. Since equivalent cure (defined below) establishes the approximate zero point of aging time, the validity of results of radiation aging studies depends on the care with which this point is determined. In particular, apparent protection of a rubber compound must be interpreted in terms of the accuracy with which equivalent cure is determined. An under-cured stock, with or without anti-rad, will use the initial radiation energy to complete the cure before apparent aging begins. Such a sample would show falsely high radiation resistance.

[4]E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Wilmington, Del.

E. E. Mooney

J. W. Born

S. T. Semegen

The Authors

John W. Born, research chemist, B. F. Goodrich Co. Research Center, received his B.S. and M.S. degrees in chemistry from the University of Chicago, in 1947 and 1948, respectively.

Mr. Born has been with the Goodrich Research Center since 1949 and since 1954 has been coordinator of radiation research under U. S. Air Force contract. He has also invented a silicone deicer product, done research on the properties of rubber compounds at high temperatures, and is credited with the discovery and development of "anti-rads" for rubber compounds.

He is a member of the American Chemical Society and the American Association for the Advancement of Science.

E. E. Mooney, research chemist, received his B.A. in chemistry from Harvard University in 1951, and his M.S. in polymer chemistry from Akron University in 1956.

Mr. Mooney has been employed by The B. F. Goodrich Co. since 1951 in rubber and plastics compounding and development and polymer research.

He is a member of the ACS and the Akron Council of Engineering & Scientific Societies.

S. T. Semegen, section leader, rubber and plastics technology, received his B.S. in rubber chemistry from the University of Akron and did graduate work in 1941, 1942.

Mr. Semegen was laboratory manager for Quaker Rubber Corp. in 1940-41; group head, rubber research, Goodrich, 1941-53; acting director, rubber research, Goodrich, 1953; and has held his present position since 1954. He has been active in a variety of fields including research compounding, development of fuel cells, deicers, tires, mechanical goods, etc.

He is a member of ACS and of its Rubber Division and Akron Section (past treasurer and counselor of the latter), AAAS, American Men of Science, Delta Epsilon Xi, Pi Kappa Epsilon, and the Akron Rubber Group.

Conversely, an overcured stock will display aged properties before irradiation begins and increased aging with irradiation. Such a sample would appear to have falsely low radiation resistance.

Equivalent cure was chosen as the basis for comparison of rubber stocks containing a potential anti-rad *versus* the control stocks. Equivalent cure is defined here as that state of vulcanization which (1) most nearly reproduces the best physical properties of the control stock, especially the modulus, and (2) is intermediate between the attainment of barely adequate cure and the beginning of "overcure." The procedure in determinations of equivalent cure involved ASTM[5] Method D 1077, plots of stress-strain properties versus curing time, and reasonable duplication of physical properties of the control stocks by those of the experimental rubber compounds in each series.

Figure 1 is a typical illustration of how equivalent curing time was selected for each of the 24 stocks in the present study. Mooney cure time is calculated both as M_7 and M_{10}, which are defined as follows:

$$M_7 = T_5 + 7\ \Delta\ 30 \quad \text{and} \quad M_{10} = T_5 + 10\ \Delta\ 30.$$

The quantity T_5 is the time required for a five-point rise in Mooney plasticity and is the time of incipient vulcanization; T_{35} is the time required for a 35-point rise; and Δ 30 equals T_{35} minus T_5. The measurements were all made on a Mooney viscometer using a large rotor at 293° F., which had been selected as the curing temperature. The Mooney cure times M_7 and M_{10} generally bracket that region of the curing rate curve of conventional polymers where the slope changes

[5]American Society for Testing Materials, Philadelphia, Pa.

TABLE 2. CURE TIME DATA FOR PRACTICAL AIRCRAFT COMPOUNDS WITH AND WITHOUT POTENTIAL ANTI-RADS

Compound 81 GH-	Material	Mooney Cure Time M_7 (Min. × 293° F.)	Mooney Cure Time M_{10} (Min. × 293° F.)	Equivalent Cure Time
311	Neoprene wire insulation-control	28	39	28
317	Neoprene wire insulation-Akroflex C	24	32	24
318	Neoprene wire insulation-quinhydrone	9	12	9
313	SBR wire insulation-control	12	15	12
327	SBR wire insulation-Akroflex C	12	14	13
328	SBR wire insulation-quinhydrone	12	16	10
357	Neoprene packing cmpd.-control	17	22	25
359	Neoprene packing cmpd.-Akroflex C	16	21	20
360	Neoprene packing cmpd.-quinhydrone	12	16	15
358	Hycar packing cmpd.-control	23	30	30
365	Hycar packing cmpd.-Akroflex C	17	22	25
366	Hycar packing cmpd.-quinhydrone	97	136	135
386	Hycar-PVC Resin bladder-control	15	18	18
391	Hycar-PVC Resin bladder-Akroflex C	14	17	17
393	Hycar-PVC Resin bladder-quinhydrone	91	125	125
387	Hycar self-sealing cell liner-control	10	12	12
395	Hycar self-sealing cell liner-Akroflex C	8	9	10
397	Hycar self-sealing cell liner-quinhydrone	37	51	225
420	Hycar-SBR tube stock-control	12	15	15
423	Hycar-SBR tube stock-Akroflex C	11	14	12
425	Hycar-SBR tube stock-quinhydrone	23	31	23
421	Neoprene tube stock-control	13	17	13
425	Neoprene tube stock-Akroflex C	10	14	10
427	Neoprene tube stock-quinhydrone	5	7	7

rapidly, that is, where the vulcanization nears completion. This region normally defines "optimum cure." The vertical lines which intersect the curves in Figure 1 mark the equivalent cure times. The calculated Mooney cure times and selected equivalent cure time are given for each stock in WADC Technical Report 55-58 Part IV[3]. Since aircraft rubber compounds must meet certain property specifications, equivalent cure for the stocks containing potential anti-rads was not always synonymous with the Mooney "optimum cure." (See Table 2.)

Sample Testing

Stress-strain testing of the rubber compounds was conducted in accordance with ASTM Method D 412-51T on standard die C dumbbells. The entire testing of experimental dumbbells was done by the same operator on the same Scott Tester[6] machine. This test procedure produced consistent results. The Shore[7] A durometer hardnesses were measured at room temperature in accordance with ASTM Method D 676.

Radiation and Heat Aging

Careful consideration indicated the necessity of determining both the separate and combined effects of prolonged heating and nuclear irradiation. The ultimate goal is to be able to predict the resistance of any type of conventional rubber compound to any reasonable combination of heat aging and radiation exposure. From an engineering viewpoint a knowledge of the interaction of these two environmental factors is important in predicting the service performance of rubber compounds in future aircraft applications.

The elevated temperatures which were chosen for the overall study of conventional rubber compounds were 158, 212, and 280° F. It is recognized that these are not high temperatures according to present concepts for materials for aircraft. The practical rubber compounds, however, which are currently in use in aircraft are not particularly high-temperature materials. Also, exposure to nuclear radiation during heating accelerates gross deterioration. Furthermore, the periods of time required to accumulate large radiation exposures represent comparatively very long heat aging times of up to three weeks. For these several reasons, conservative initial elevated temperatures were chosen. The present work involved only room temperature and 158° F. and so represents approximately one half of the full study.

Different combinations of heat, radiation exposure, and testing conditions were imposed on the dumbbell samples. Six methods of such exposure and testing were employed for the 24 compounds as follows:

Method Number	Irradiation Temperature	Testing Temperature
I	R. T.	R. T.
II	158° F.	R. T.
III	158° F.	158° F.
IV	R. T.	158° F.
Method Number	**Heat Aging Temperature**	**Testing Temperature**
V	158° F.	R. T.
VI	158° F.	158° F.

R.T.=room temperature.

Irradiations at room temperature were conducted to cumulative exposure doses of 210 x 10^7, 420 x 10^7, 840 x 10^7, and 1260 x 10^7 ergs per gram of carbon. The irradiations at 158° F. were carried out at 84 x 10^7, 168 x 10^7, 336 x 10^7, and 587 x 10^7 ergs per gram of carbon.[8] Heat aging at 158° F. was conducted for periods of time suitable for each stock.

[6]Scott Testers, Inc., Providence, R. I.

[7]Shore Instrument & Mfg. Co., Inc., Jamaica, L. I., N. Y.

[8]The erg per gram of carbon has been recommended by the ANP Advisory Committee for Nuclear Measurements and Standards for all Air Force programs of radiation research and development. It is the unit of "carbon dose," which is defined as the energy removed from an X- or gamma radiation field per unit mass (hence erg per gram) by a limitingly small piece of carbon. "Carbon dose," as measured by a carbon equivalent ionization chamber, has been chosen as the common denominator of gamma dosimetry.

One roentgen-equivalent-physical, another term in common use before "ergs per gram of carbon" was recommended, is equivalent to 84.6 ergs of absorbed radiation energy (produced by Compton scattering) per gram of carbon.

One roentgen-equivalent-physical equals 93.0 ergs of absorbed ionizing radiation energy per gram of tissue.

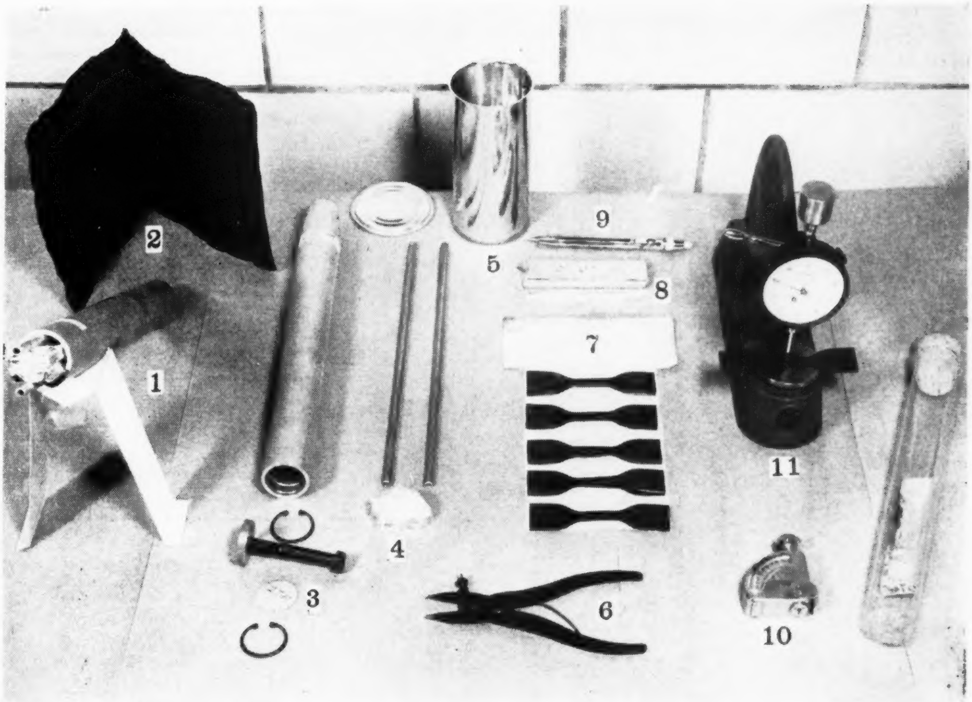

Fig. 2. Equipment used in packaging dumbbell specimens for exposure to heat and radiation. (See text for details)

Figure 2 shows the equipment used in packaging the dumbbells for their exposure to heat and radiation. From front to rear and left to right the items are as follows: (1) the aluminum canister used for Cobalt 60 gamma irradiations at Brookhaven National Laboratory, packed with dumbbell samples and small-tube spacers; (2) Teflon[9]-coated aluminum sheets for curing rubber; (3) the parts of the canister: namely, closure ring, identification tab, closure disk with removing bolt temporarily attached, closure ring, and canister; (4) aluminum tube and pyrex glass wool spacers; (5) "tin" sample container for MTR[10] gamma irradiations; (6) pliers for closure rings; (7) five typical rubber dumbbell samples and aluminum foil wrapping; (8) wrapped package of five dumbbells; (9) Tech Pen for labeling packages; (10) Shore A durometer; (11) thickness gage; and (12) test tube containing a package of dumbbells for heat aging.

The data were compiled on the basis of the median value of five dumbbells of each compound for tensile strength, ultimate elongation, and modulus. Exposure to heat and radiation was made in air in closed containers using test specimens wrapped in aluminum foil. Dumbbells were wrapped compactly in sets of five. Each dumbbell in the set was separated by foil from the others. This procedure accomplished two objectives: namely, (1) maximum use of the limited space in the containers for irradiation at Brookhaven National Laboratory (cobalt 60) and the Materials Testing Reactor Gamma Facility (spent reactor fuel elements) and (2) prevention of cross-contamination of samples.

Results and Discussion

The experimental results, which appear in detail in WADC Technical Report 55-58 Part IV, are summarized in Tables 2 through 7. Table 2 describes the 24 compounds according to elastomer and use and gives the Mooney and equivalent cure times. Again, the first number in each series of three identifies the conventional control stock. The subsequent two compounds contain the potential anti-rads Akroflex C and quinhydrone, respectively. Akroflex C had little effect on any of the cure times. In general, quinhydrone had little effect on SBR cure time, moderately accelerated neoprene cure, and greatly retarded the NBR (Hycar) cure. The important point is that equivalent cures were obtained in each series, permitting valid comparisons of radiation and heat resistance.

Method I

Table 3 presents the results of Method I, involving irradiation and testing at room temperature. There are many ways of evaluating the data. Basically, the ratio of radiation-induced cross-linking to chain scission is of prime importance. In stress-strain testing, ultimate elongation has proved most useful for following the progress of radiation damage. Two criteria were employed in evaluation. First, the exposure dose required to reduce the initial elongation by one half was tabulated, as shown in column 3. Second, the % reduction

[9]Polytetrafluoroethylene, E. I. du Pont de Nemours & Co., Inc.
[10]Materials Testing Reactor Gamma Facility, Idaho Falls, Idaho.

TABLE 3. THE EFFECTS OF GAMMA RADIATION ON % RETAINED ELONGATION OF PRACTICAL AIRCRAFT COMPOUNDS WITH AND WITHOUT POTENTIAL ANTI-RADS

Method I

Rubber Compound Number 81 GH-	Radiation Flux (10^7 Ergs/Gram (C)/Hr.)	Dose Required to Reduce % Retained Elongation by 50% (10^7 Ergs/Gram/Carbon)	Reduction in % Retained Elongation after Indicated Dose (10^7 Ergs/Gram/Carbon) 587	1260
311	2.33	294	80	92
317	2.33	386	66	90
318	2.33	294	68	90
313	2.60	680	44	72
327	2.60	1470	32	47
328	2.60	705	46	70
357	2.52	151	94	96
359	2.52	252	88	92
360	2.52	285	73	93
358	2.52	218	80	88
365	2.52	403	65	75
366	2.52	462	57	76
386	2.52	151	84	96
391	2.52	344	72	85
393	2.52	487	56	75
387	2.52	193	75	90
395	2.52	487	57	76
397	2.52	546	53	68
420	2.52	503	54	62
423	2.52	470	54	58
425	2.52	579	50	55
421	2.52	370	64	85
427	2.52	361	68	86
429	2.52	244	80	88
	Total:	10,300	1560	1905
	Average per compound:	430	65	79

TABLE 4. THE EFFECTS OF GAMMA RADIATION ON % RETAINED ELONGATION OF PRACTICAL AIRCRAFT COMPOUNDS WITH AND WITHOUT POTENTIAL ANTI-RADS

Method II

Rubber Compound Number 81 GH-	Radiation Flux (10^7 Ergs/Gram (C)/Hr.)	Dose Required to Reduce % Retained Elongation by 50% (10^7 Ergs/Gram/Carbon)	Reduction in % Retained Elongation after 587×10^7 Ergs/Gram (C) Exposure
311	2.33	302	60
317	2.33	244	70
318	2.33	126	87
313	2.33	587	48
327	2.33	587 ($-\Delta$44%)	44
328	2.33	462	52
357	2.52	113–117*	90–90*
359	2.52	151–163*	88–88*
360	2.52	243–235*	86–82*
358	2.52	206–180*	74–73*
365	2.52	218–189*	72–69*
366	2.52	248–281*	68–64*
386	2.52	202	78
391	2.52	227	77
393	2.52	328	66
387	2.52	227	89
395	2.52	361	62
397	2.52	478	57
420	2.52	336	55
423	2.52	587	50
425	2.52	587 ($-\Delta$47%)	47
421	2.52	268	72
427	2.52	428	64
429	2.52	268	72
	Total:	7770	1607
	Average per compound:	324	67

*Results from duplicate studies.

from the initial ultimate elongation was recorded after two particular exposure doses: namely, 587 x 10^7 and 1260 x 10^7 ergs per gram of carbon, as shown in columns 4 and 5.

In terms of the 50% reduction, the appreciable superiority of SBR is apparent. The SBR wire insulation series, Compounds 81GH313, 327, and 328, had from two to four times the resistance to radiation damage of the other series. Consistent with this, the Hycar-SBR tube stock series (420, 423, 425) were next highest in resistance, indicating that the addition of SBR can afford significant protection to a Hycar compound. The most radiation-resistant stock (327) was SBR wire insulation containing Akroflex C, which was more resistant than the control stock. Although the conventional NBR (Hycar) control stocks appeared the least resistant, in general they received the most overall benefit from the potential anti-rads Akroflex C and quinhydrone.

The tensile strengths of most of the stocks except the low durometer neoprene and Hycar packing compounds (81GH357, 359, 360 and 81GH358, 365, and 366, respectively) remained quite constant throughout the range from zero to 587 x 10^7 ergs per gram of carbon. The potential anti-rads generally improved the retention of ultimate elongation and moderately inhibited increases in modulus. The rapid decrease in both tensile strength and ultimate elongation of the packing compounds in the range of zero to 210 x 10^7 ergs per gram of carbon accounts for the small increase in modulus. All compounds exhibited greater hardness with increasing radiation exposure. Apparently the lower the initial hardness, the greater is the % increase in hardness as a function of irradiation. Since the radiation-induced changes in these properties do not reflect the progress of radiation damage as clearly as do changes in ultimate elongation, graphs are not presented here for these physical properties.

Methods II, III, IV

Similarly, Tables 4, 5, and 6 present the data for Methods II, III, and IV, respectively. Nearly the same qualitative remarks can be made in the cases of these tables as for Table 3. In most cases where protection

TABLE 5. THE EFFECTS OF GAMMA RADIATION ON % RETAINED ELONGATION OF PRACTICAL AIRCRAFT COMPOUNDS WITH AND WITHOUT POTENTIAL ANTI-RADS

Method III

Rubber Compound Number 81 GH-	Radiation Flux (10^7 Ergs/Gram (C)/Hr.)	Dose Required to Reduce % Retained Elongation by 50% (10^7 Ergs/Gram/Carbon)	Reduction in % Retained Elongation after 587×10^7 Ergs/Gram (C) Exposure
311	2.33	176	84
317	2.33	193	74
318	2.33	101	84
313	2.33	403	54
327	2.33	420 (−Δ43%)	43
328	2.33	487	54
357	2.52	168	82
359	2.52	210	82
360	2.52	319	66
358	2.52	294	65
365	2.52	487	53
366	2.52	344	60
386	2.52	176	84
391	2.52	227	78
393	2.52	235	78
387	2.52	244	75
395	2.52	336	61
397	2.52	395	58
420	2.52	487	53
423	2.52	587 (−Δ48%)	48
425	2.52	587 (−Δ40%)	40
421	2.52	252	71
427	2.52	302	61
429	2.52	168	74
	Total:	7630	1582
	Average per compound:	318	66

TABLE 6. THE EFFECTS OF GAMMA RADIATION ON % RETAINED ELONGATION OF PRACTICAL AIRCRAFT COMPOUNDS WITH AND WITHOUT POTENTIAL ANTI-RADS

Method IV

Rubber Compound Number 81 GH-	Radiation Flux (10^7 Ergs/Gram/(C)/Hr.)	Dose Required to Reduce % Retained Elongation by 50% (10^7 Ergs/Gram/Carbon)	Reduction in % Retained Elongation after Indicated Dose (10^7 Ergs/Gram/Carbon) 587	1260
311	8.1–19.4	122	88	95
317	8.1–19.4	183	82	95
318	8.1–19.4	166	87	95
313	8.1–19.4	678	47	73
327	8.1–19.4	853	42	64
328	8.1–19.4	462	60	76
357	8.1–19.4	87	88	94
359	8.1–19.4	174	89	96
360	8.1–19.4	174	77	91
358	8.1–19.4	226	80	89
365	8.1–19.4	384	61	85
366	8.1–19.4	296	69	84
386	9.6–27.3	87	82	93
391	9.6–27.3	252	77	86
393	9.6–27.3	174	76	86
387	9.6–27.3	218	78	86
395	9.6–27.3	418	60	77
397	9.6–27.3	296	66	80
420	9.6–27.3	384	60	78
423	9.6–27.3	435	54	66
425	9.6–27.3	697	47	65
421	9.6–27.3	166	82	91
427	9.6–27.3	183	79	91
429	9.6–27.3	209	83	94
	Total:	7324	1714	2030
	Average per compound:	305	71	85

occurred, however, the anti-rads provided less protection in the latter methods than in Method I. That is, Methods II through IV, which involved heating, were more drastic on the average than Method I. This point is illustrated by the averages of the third columns in the corresponding tables.

In general, the control stocks had only slightly less radiation resistance by Method II than by Method I. It thus appears that heating at 158° F. throughout the radiation exposure has little effect on the extent of radiation damage to conventional stocks, when the samples are tested subsequently at room temperature. When both irradiation and testing take place at 158° F. (Method III), the superior heat resistance of NBR (Hycar) becomes important. The NBR compounds without potential anti-rads either underwent no significant change or else nominally increased in radiation resistance under Method III, as compared with Method I. It is interesting that in terms of absolute rather than relative resistance the Hycar-SBR stocks, (420, 423, 425) which combine the good heat resistance of NBR with the good radiation resistance of SBR, are the best of all the 24 rubber compounds when tested by Method III.

Comparison of Methods I-IV

The results for Method IV, involving irradiation at room temperature and testing at 158° F., are stated in Table 6. The results of all four methods are compared in Table 7. The second, third, and fourth columns show the differences in exposure dose necessary to decrease the initial ultimate elongation by one half. The second column shows the decrease in required dose which results from testing at 158° F. instead of room temperature. The third column gives the decrease in required dose caused by irradiating at 158° F. instead of room temperature. The fourth column shows the corresponding decrease when both irradiation and testing take place at 158° F., as compared with room temperature.

The second and third columns permit a preliminary comparison of the effects of heat and radiation. Heating during testing (Method IV) of the neoprene stocks causes a greater decrease in required dose than does heating during irradiation (Method II). In the cases of the NBR (Hycar) and SBR stocks, the comparison does

TABLE 7. A COMPARISON OF THE TEST RESULTS OF METHODS I-IV

Compound 81 GH-	Decrease in Dose to Reduce Ultimate Elongation by One-Half, 10^7 Ergs/Gram of Carbon		
	Method I-Method IV	Method I-Method II	Method I-Method III
	(RT-RT) (RT-158° F.)	(RT-RT) (158° F.-RT)	(RT-RT) (158°-158° F.)
311	1.72	−0.08	1.18
317	2.03	1.42	1.93
318	1.28	1.68	1.83
313	0.02	0.93	2.77
327	6.17	8.83	10.50
328	2.43	2.43	2.18
357	0.64	0.36	−0.17
359	1.78	0.95	0.42
360	1.11	0.42	−0.66
358	−0.08	0.25	−0.76
365	0.19	2.01	−0.84
366	0.66	0.98	1.18
386	0.64	−0.51	0.25
391	0.92	1.17	1.17
393	3.13	1.59	2.52
387	−0.25	−0.34	−0.51
395	0.69	1.26	1.51
397	2.50	0.68	1.51
420	1.19	1.67	0.16
423	0.35	−1.17	−1.17
425	−1.18	−0.08	−0.08
421	2.04	1.02	1.18
427	1.78	−0.67	0.59
429	0.35	−0.24	0.76

TABLE 8. PROTECTION RATIOS FOR PRACTICAL AIRCRAFT COMPOUNDS WITH AND WITHOUT POTENTIAL ANTI-RADS PRESENT

Compound 81 GH-	Potential Anti-Rad	Protection Ratio—Method I	II	III	IV
311	None (control)	1.0	1.0	1.0	1.0
317	Akroflex C	1.3	0.8	1.1	1.5
318	Quinhydrone	1.0	0.4	0.6	1.4
313	None (control)	1.0	1.0	1.0	1.0
327	Akroflex C	2.2	1.0	1.0	1.3
328	Quinhydrone	1.0	0.8	1.2	1.7
357	None (control)	1.0	1.0	1.0	1.0
359	Akroflex C	1.7	1.2	1.3	2.0
360	Quinhydrone	1.9	1.9	1.9	2.0
358	None (control)	1.0	1.0	1.0	1.0
365	Akroflex C	1.8	1.1	1.7	1.7
366	Quinhydrone	2.1	1.2	1.2	1.3
386	None (control)	1.0	1.0	1.0	1.0
391	Akroflex C	2.3	1.1	1.3	2.9
393	Quinhydrone	3.2	1.6	1.3	2.0
387	None (control)	1.0	1.0	1.0	1.0
395	Akroflex C	2.5	1.6	1.4	1.9
397	Quinhydrone	2.8	2.1	1.6	1.4
420	None (control)	1.0	1.0	1.0	1.0
423	Akroflex C	0.9	1.8	1.2	1.1
425	Quinhydrone	1.2	1.8	1.2	1.8
421	None (control)	1.0	1.0	1.0	1.0
427	Akroflex C	1.0	1.6	1.2	1.1
429	Quinhydrone	0.7	1.0	0.7	1.3
	Totals	35.6	29.0	27.9	34.4

not yet lead to clear-cut conclusions. Further study by Methods V and VI at 158° F., which is in progress, and by all six methods at 212 and 280° F. should provide clarification.

When the values in the second and third columns are added for each compound, the sum exceeds the value in the fourth column in 22 out of 24 cases. Thus it appears that the separate effects of heat on the rate of radiation damage and on the physical test values do not add in a simple manner. The results indicate that both irradiation and testing should be conducted at the service temperature of interest. Apparently less radiation damage is done by the combination of both irradiating and testing at 158° F. than the sum of the separate effects would predict.

Radiation Protection Ratios

Radiation protection ratios are listed in Table 8. The protection ratio is defined as the ratio of the exposure required to reduce the ultimate elongation by one half for a stock containing a potential anti-rad to the corresponding exposure for the control compound. The Hycar self-sealing fuel cell liner stocks (81GH387, 395, and 397) received the most overall benefit from the two potential anti-rads. The maximum improvement in this series, achieved by quinhydrone, can be expressed as 2.8/2.1/1.6/1.4 for Method I/Method II/ Method III/Method IV. The protection provided by these two additives ranged from none up to 3.2-fold protection for the rubber compounds involved. In most cases where protection occurred, the anti-rads provided more protection in Method I than in Methods II and III.

Summary and Conclusions

Thus 24 rubber compounds representing four important classes of aircraft rubber applications have been tested by four methods to study heat and radiation resistance. Potential anti-rads were included to learn what protection can be provided against radiation damage. The results of the first phase, involving heating to 158° F. during irradiation and testing, have been largely reported in summary.

The importance of equivalent cure of rubber compounds for valid comparison was recognized, and equivalent cures were obtained. The tensile strengths of most of the stocks except the low durometer neoprene and Hycar packing compounds remained quite constant throughout the exposure range from zero to 587 x 10^7 ergs per gram of carbon. All compounds exhibited greater hardness with increasing radiation exposure. Apparently the lower the initial hardness, the greater is the % increase in hardness as a function of

(*Continued on page 392*)

Present Status of Latex Rubber Foam[1]

By T. H. ROGERS and K. C. HECKER
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DURING the past few years the latex rubber foam industry has been under increased pressure to establish its price structure on a more uniform and constant basis. In order to accomplish this, the industry is presently using a greater percentage of synthetic rubber than ever before. The present trend is toward higher quantities of synthetic in foam, and even up to 100% synthetic for some applications.

Natural rubber latex has been the basic raw material used in latex foam since the industry's birth some two and a half decades ago. It is an agricultural product, and typical of most farm products, its price varies over a considerable range. Because of the high quality of natural rubber foam, its present-day market value in this country is now in excess of $275 million per annum.

The purpose of this paper is to show the variation in physical properties of latex foam when made using 100% synthetic rubber as the polymer.

Types of Synthetic Latices for Foam Application

Synthetic rubber latex, in varying percentages of the composition of foam rubber, has been used over a long period of time (1).[2] Neoprene rubber latex was perhaps the first to be used for this purpose, and it is presently being used in making foam of 100% synthetic rubber composition (2). The relatively high cost of this type of latex, however, and some undesirable properties, such as its high odor level, have relegated its use to certain specialty items.

Styrene-butadiene polymer latices, wherein the ratio of combined monomers varies from 0/100 to 30/70, have accounted for the greatest quantity for synthetic latex used in foam rubber. The "hot synthetic latices," which were used chiefly as extenders, eventually gave way to their "cold" counterparts (1). Because the "cold latices" had improved stress/strain values and better wet gel strength, greater quantities could be used in blends with natural rubber latex to make foam rubber. SBR 2105(3), which is a "cold" 25 styrene/-75 butadiene polymer latex made using a sulfoxylate recipe, with a soap system consisting of a mixture of rosin acid and fatty acid soaps, polymerized to 60% conversion, and concentrated to a total solids content of 60 to 63%, is presently the most popular commercial synthetic latex used in foam applications. In the three years that private industry has been operating the synthetic rubber plants, improvements in SBR 2105

[1]Presented before the Division of Paint, Plastics & Printing Ink Chemistry, ACS, Sept. 9, 1958, Chicago, Ill.

[2]Numbers in parentheses refer to bibliography references at the end of this article.

Present Status of Latex Foam

In recent years the latex foam rubber industry has been urged to provide a more uniform and constant price structure for its products. In this connection the industry is now using a higher percentage of synthetic rubber latex, and in some cases up to 100% in the manufacture of foamed rubber, since this increased use of synthetic rubber latex results in more uniform processing and lower cost. Substantial quantities of the low-cost inorganic fillers can be used in 100% synthetic rubber foam.

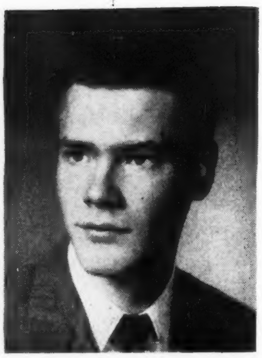
Latex foam of 100% synthetic rubber composition has improved long-term aging properties as measured by accelerated test methods. Such foam has excellent flex life and the hysteresis and resilience values are very good, being equivalent to those of 100% natural rubber foam. Increased pigment loading decreases resilience, making the foam approximately equivalent to polyether urethane foam in this value.

Stress-strain properties of 100% synthetic rubber foam are inferior to those of natural rubber foam, but they are adequate for most cushioning applications. Pigment loading (up to 20%) of 100% synthetic rubber foam does not adversely affect stress-strain values. Compression set properties at 50% deflection and 90% deflection are excellent.

The low-temperature properties of the synthetic rubber foam are not quite so good as those of the natural rubber foam, but they are substantially better than those for other types of elastomeric foams presently being produced.

The all-synthetic rubber foam can be molded or made into slab stock using conventional equipment.

T. H. Rogers



K. C. Hecker

The Authors

T. H. Rogers, head of latex and foam rubber research, Goodyear Tire & Rubber Co., received his B.S. in chemical engineering from Northeastern University in 1937 and completed graduate work in rubber and latex chemistry and technology at the University of Akron.

Since joining Goodyear in 1937, Mr. Rogers has done research and development work on plastics, cyclized rubber, latex and foamed rubber applications. He holds more than 100 United States and foreign patents and is the author of many articles in these fields.

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K. C. Hecker, latex chemist, Goodyear, was graduated from Youngstown University in 1956 with a B.A. degree in chemistry and completed graduate work in rubber and polymer chemistry at the University of Akron.

Mr. Hecker is a member of the ACS and the American Institute of Chemists.

latex have been made which makes it even more suitable for use in foam rubber.

Freeze/agglomerated-type latices, which are made by subjecting small particle size styrene/butadiene latex to one or more freeze-quick thaw cycles in order to mass the particles into larger-size colloids, are presently being used in foam rubber (4, 5). These latices have a relatively large particle size and in many cases may be concentrated up to 68.0% total solids and still be fluid. Several companies produce this type of latex, and it shows promise of acceptance in foam products by the industry.

A new latex, Pliolite Latex 5350 (6), which is a high solids styrene/butadiene latex similar to Pliolite Latex 2105, but having higher total solids and improved color stability, is presently being recommended for its improved foam processing characteristics.

The properties of a latex which is suitable for foam rubber application may be selected from a composite of the latices just described. High total solids with relatively low viscosity, low coagulum content, pH of approximately 10, and good mechanical stability are desirable. The most important characteristic of a latex, which usually is not evident from these values, is its foam processing ability. This is usually obtained by the conventional method of processing the latex into foam. This normally is described as the Dunlop process (7).

Experimental Details

The synthetic latex that we have used for the foam described in this report is a 25 styrene/75 butadiene combined polymer system made with a recipe having significant changes as compared with SBR 2105 latex. This latex is still in the pilot-plant stage, and it is designated as Pliolite Latex 5352X (6). The physical properties of a typical batch of this latex are as follows:

PLIOLITE LATEX 5352X

Total solids[a]	68.3%
pH[a]	10.2
Surface tension[a] at 40% total solids	39 dynes/cm.
Average particle size[b]	3000 Angstroms
Stabilizer	fatty acid soap
Antioxidant	none
Residual styrene (max.)[a]	0.10%
Coagulum (max.)[a]	0.10% on 80 mesh
Mooney viscosity at contained polymer ML-4[c]	120
Mechanical stability[d]	very good
Gel[e]	0%
Brookfield viscosity spindle[f] #2	
60% TS at 85° F. at 3 rpm.	200 cps.
6 rpm.	160 cps.
12 rpm.	110 cps.
30 rpm.	88 cps.

[a]ASTM D 1417-57T, American Society for Testing Materials, Philadelphia, Pa.
[b]W. C. Brown, *J. Applied Phys.*, 18, 273, 1947.
[c]ASTM D 927-57T.
[d]W. A. Linbeck and F. E. Woltz, "Stability Test for Latices." U. S. Government, RFC-SPT 153, Oct. 24, 1946.
[e]Reconstruction Finance Corp., Office of Rubber Reserve Report CR-232, Dec. 22, 1943.
[f]Brookfield Engineering Laboratories, Inc., Stoughton, Mass.

This latex was compared in foam with a centrifuged natural rubber latex of 63.0% solids. In order to obtain maximum compression efficiency, that is, the highest foam compression or hardness per unit density, the compounding materials were matured in the natural latex for 16 hours at 75° F, whereas the synthetic latex mix was not matured.

The foam samples were all made by air frothing of the latex with subsequent gelation by use of an acid salt. This method is usually referred to as the Dunlop process. The Talalay process for making foam rubber, which consists of expanding the latex with a gas liberated within the mix, and subsequently freezing the foam, and coagulating the frozen mass with a gas such as

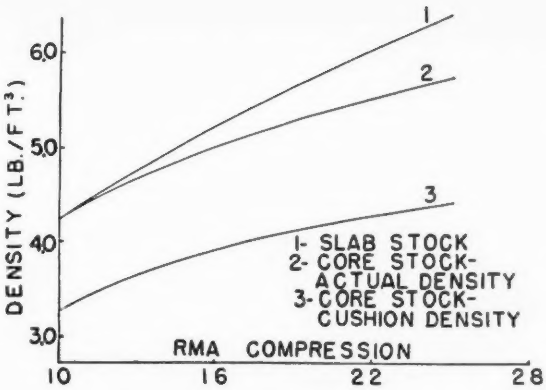

Fig. 1. Comparison of latex rubber foam slab and core stock with regard to density and RMA compression

carbon dioxide, could also be used in comparing these latices (8).

The compound formulation used for making the foams was a typical one consisting of 2.0 parts sulfur, 0.5-part zinc diethyldithiocarbamate,[3] 1.5 parts zinc mercaptobenzothiazole, 1.5 parts Wing-Stay S[4] antioxidant, 3.0 parts zinc oxide, and 0.25-part Trimene Base[5]—all based on 100 parts of the total solids of the latex. Rosin acid soap and oleic acid soap were used as the frothing aids. Sodium silicofluoride, as a 25% dispersion, was used as the gelant.

Cushions were made from laboratory-size molds (24.1 cm. x 12.8 cm. x 4.1 cm.) having a core displacement volume of 18%. Optimum gel and soap times on the latex compounds were obtained for all of the test specimens used in the data, which means that the gelling process was so controlled that the rubber phase set shortly before (about four minutes) the soap was destroyed by the decrease in pH resulting from the continuing hydrolysis and dissociation of the sodium silicofluoride. Vulcanization was done at atmospheric steam pressure (212° F) for 20 minutes, and drying was completed in an air oven at 220° F.

Discussion of Results

Figure 1 shows the economic advantage of making latex foam cushions from cored stock as compared with slab stock (9). The samples described here are 1½ inches in thickness and consist of a blend of 70 parts natural rubber and 30 parts synthetic rubber. Curve 1, which is slab stock, has a much higher density per unit of compression, as compared with the cored stock, Curve 3. This indicates the advantage in compression efficiency that foam cored stock has over foam slab stock. It also shows the error one makes in comparing elastomeric cellular foams only on a slab stock basis. Curve 2 is the core stock cushion plotted on its actual density, minus the cores.

The use of foam rubber is largely in cushioning applications, and cored stock, which accounts for approximately 80% of the foam produced, is ideally suited for this purpose. It can be molded into practically all types of shapes, and the cores may be arranged in many different ways to give higher or lower compression, whichever is desired. The outstanding example of this compression variation is the foam rubber mattress which permits uniform cushioning over the entire body.

Figure 2 shows a vulcanized foam rubber cushion being stripped from the mold on a continuous production line.

Figure 3 depicts the weight savings resulting from increased core volume of cushions (18 lbs. RMA Compression[6]). As the thickness of the cushion is increased, the core hole volume may be increased, and the stock efficiency of the foam rubber is greatly improved (9).

Figure 4 shows the compression efficiencies of cored stock foam consisting of 100% natural rubber (1), 100% synthetic rubber (2), and 100% synthetic rubber containing 20 parts of clay loading (3). At the higher compressions the foams containing synthetic rubber

Fig. 2. Cored foam rubber cushion being stripped from mold during manufacturing operation

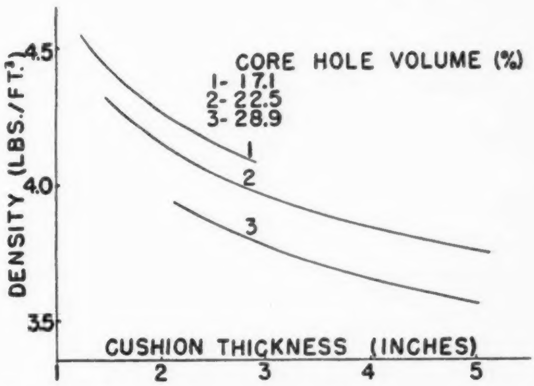

Fig. 3. Relation between core hole volume and density for cushions of varying thicknesses

[3]Ethyl Zimate, R. T. Vanderbilt Co., New York, N. Y.
[4]Blend of substituted phenols, Goodyear Tire & Rubber Co., chemical division, Akron, O.
[5]Ethyl chloride, formaldehyde, and ammonia reaction product, Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.
[6]"Buyers' Specification—'Latex Foam,'" (as revised Dec. 10, 1956). The Rubber Manufacturers Association, Inc., 444 Madison Ave., New York, N. Y.

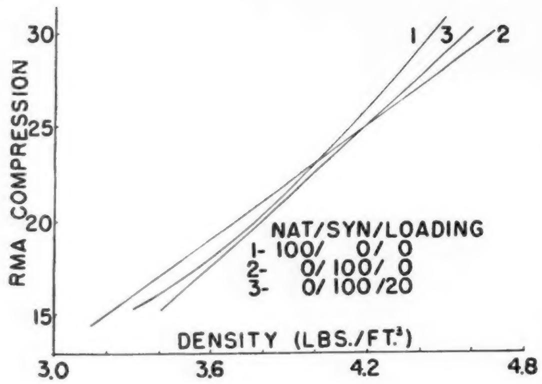

Fig. 4. Compression efficiencies of natural and synthetic rubber foams (core stock)

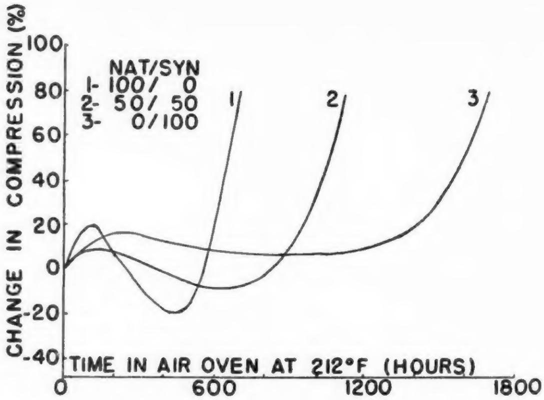

Fig. 6. Air oven aging of latex rubber foams

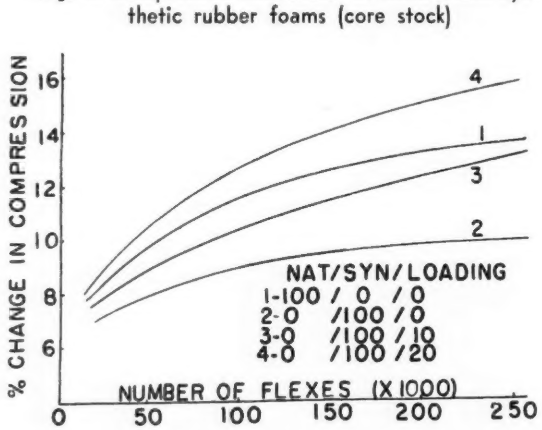

Fig. 5. Flex life of natural and synthetic rubber foams and synthetic rubber foams loaded with 10 and 20 parts of pigment

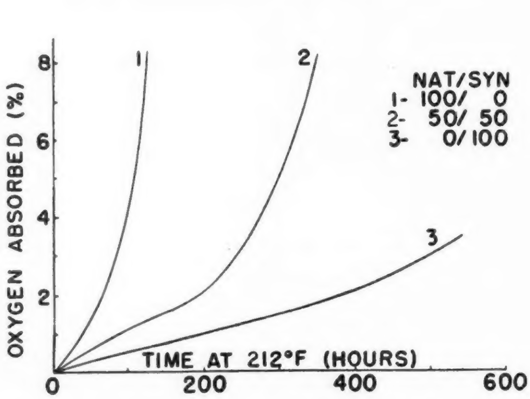

Fig. 7. Oxygen absorption of latex rubber foams

appear to lose some compression, but the loss is relatively small. For all practical purposes these three foams have the same compression efficiency. From an economic standpoint the synthetic foam containing the loading represents a very low cost formulation. Core type cushions containing up to 40 parts of pigment loading have been made in the laboratory, but difficulty has been experienced in stripping them from the molds. Slab stock containing in excess of 50 parts loading has also been made.

Figure 5 shows that as the pigment loading of a water washed, water fractionated, 0.60-micron average particle size Kaolin clay is increased up to 20 parts, the flex life decreases. The % change in compression, as measured on the ordinate, represents a decrease in compression, and, as the number of flexes is increased up to 250,000, as measured on the abscissa, the cushions become softer, primarily owing to structure breakdown. These core-type cushions were 18 lbs. RMA in compression and were deflected 50% of their original gage during flexing at four flexes/second.[6] The synthetic foam is better than the natural foam in this test.

Figure 6 shows the effect of the long-term air oven aging when the synthetic rubber content in the foam is increased up to 100% (10). The synthetic rubber greatly improves the aging properties of the foam.

Figure 7 indicates that in the oxygen absorption testing (10) of these foams, the presence of synthetic rubber greatly improves the aging properties.

Figures 8A, 8B, 8C, and 8D show the hysteresis loops of the various latex foams. The all-natural rubber foam has the lowest hysteresis loss, 25.0%, and the all synthetic is slightly higher with a loss of 26.5%. Although 10 parts of loading make very little change in this value, 20 parts loading increases it to 33.1%. This value, however, is still lower than that of polyurethane and vinyl foams.

The hysteresis loops are an indication of the comparative resiliency of the foams. In rubber technology, resiliency is usually thought of as the ratio of returned energy to the impressed energy. As the load, or compression, on the foam rubber cushion is increased, as measured on the abscissa, the deflection in %, as measured on the ordinate, is increased, or the gage of the sample is decreased. Then, as the load is slowly removed from the foam rubber cushion, the deflection is greater for each unit of load, indicating an energy loss.

The determination of this energy loss for flexible foams may be depicted by plotting their hysteresis loops. The hysteresis loss is determined by dividing the area contained within the loop by the total area contained under the initial load/deflection curve as measured from

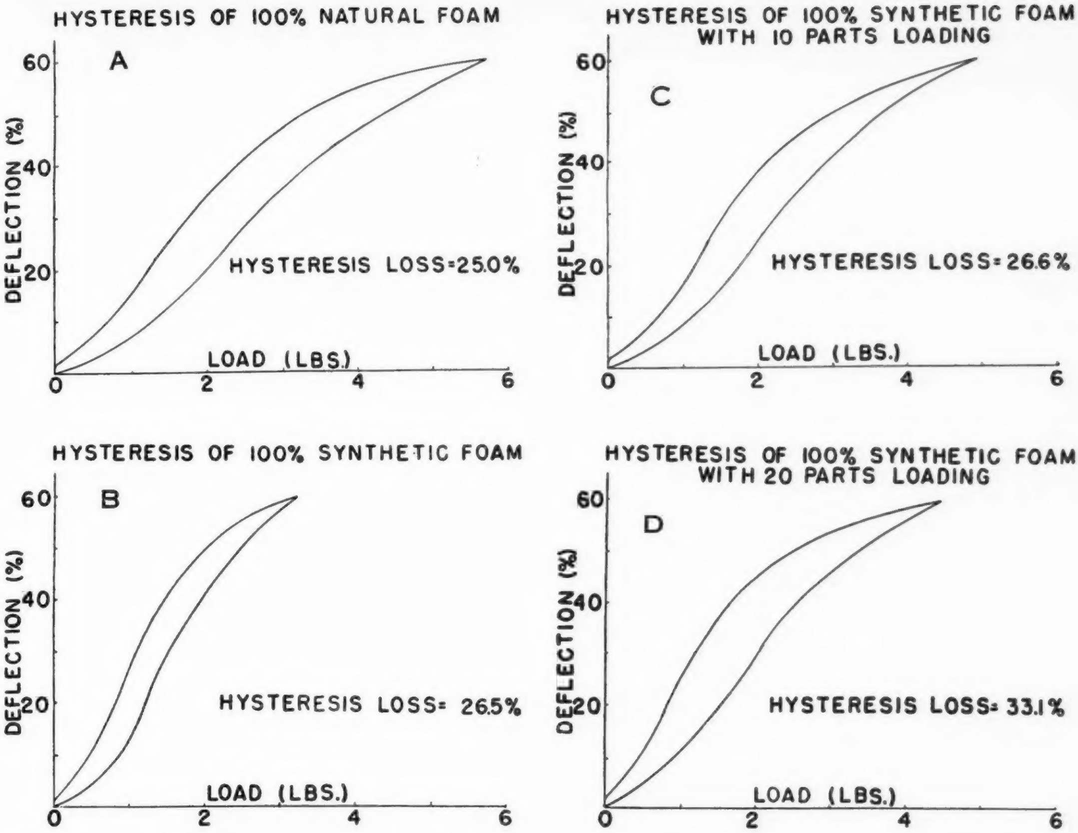

Fig. 8. Hysteresis values and hysteresis loops for A, 100% natural rubber foam; B, 100% synthetic rubber foam; C, 100% synthetic rubber foam loaded with 10 parts of clay; and, D, 100% synthetic rubber foam loaded with 20 parts of clay

the ordinate axis, and this value is multiplied by 100 to give the hysteresis loss in per cent. The perfect elastomeric foam would have no hysteresis loss. As the hysteresis loss increases, the foam is less resilient.

Table 1 lists the other important properties of natural rubber latex foam and synthetic rubber latex foam with varying quantities of loading. The tensile and the elongation values were obtained by using a sample of slab sliced from the skin side of the cushion. The other values were all obtained on the regular core cushion.

Observe the tensile and the elongation values of the synthetic foam. Although the pigment loading does decrease the values, they are still quite adequate for most cushioning applications. The compression set values of the synthetic foam, both at 50% deflection and 90% deflection, are superior to those of the natural foam.

Resilience appears to be of the same order as the hysteresis loss values, which is to be expected. The resilience of the synthetic rubber foam containing 20 parts clay loading, although low compared with the other latex foams, is far better than that obtained with polyurethane and vinyl foams.

TABLE 1. PHYSICAL PROPERTIES OF FOAM RUBBER CORE STOCK

		100% Synthetic Latex Foam		
Properties	100% Natural Latex Foam	No Loading	10 Parts Clay Loading	20 Parts Clay Loading
Tensile strength, psi.[a]	15.0	9.0	8.0	7.4
Elongation, %[a]	310	225	218	211
Compression set[b] (% retention of gage)				
50% deflection	92.7	96.6	96.4	95.5
90% deflection	90.0	96.0	94.2	93.5
Hysteresis loss, %	25.0	26.5	26.6	33.1
Resilience (rebound in %)[c]	73.0	69.0	68.0	61.5
Low temperature properties[d] (% change @ −20° F.)	10.4	11.0	24.7	26.0
Flammability[e]	burns	burns	burns	burns

[a]The tensile and the elongation values of the foam rubber specimen were made on a ½- by ½-inch thick cross-section dumbbell specimen, using an inclined plane IP4 tester made by Scott Testers, Inc., Providence, R. I.

[b]ASTM D 1055-58T.

[c]The resilience was determined by dropping an 8.3-gram steel ball of 1.26-cm. diameter from a height of 20 cm. on to a one-inch thick sample of slab stock and determining the % rebound of the ball.

[d]ASTM D 1055-58T, except that temperature was maintained at —20° F. instead of the specified —40° F.

[e]Flammability was determined by igniting the end of a one-inch wide by ½-inch thick slab of foam rubber with a Bunsen burner.

The loading appears to affect adversely low-temperature properties, but the values are again much better than those obtained from the other types of elastomeric foams.

Natural rubber foam and synthetic rubber foam are basically hydrocarbon, and they support combustion when ignited. Foam containing natural rubber, however, will resist burning when a lighted cigarette is placed on its surface. Synthetic latex foam may also be compounded to have this property (11).

Summary and Conclusions

In conclusion, we state that latex foam cushions containing core holes for good compression efficiency may be made from an improved synthetic rubber latex extended with low-cost inorganic pigment. This foam, as compared with an all-natural rubber foam, has improved aging, good flex life, excellent compression set values, and fair hysteresis and resilience properties. Stress/strain values are substantially decreased, but they are adequate for most cushioning applications. The low-temperature values are not so good as those of the all-natural, but they are substantially better than other types of elastomeric foam presently being produced.

The main advantage of an all-synthetic rubber foam is that it gives greater assurance of product price stability. Another important potential advantage, which requires long-term latex production and extended foam production experience in using the latex, is its more uniform processing characteristic as compared with foam rubber made with natural rubber latex. The latter varies considerably, depending largely on the effect of seasonal changes in the natural latex as it is produced in the Far East.

Bibliography

(1) T. H. Rogers, Rubber World, 132, 5, 612 (1955).
(2) J. C. Carl, T. E. Betchel, "Neoprene Latex Foam," Report BL-335. E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Wilmington, Del. (1957).
(3) ASTM 1418-58T—Tentative Recommended Practice for Nomenclature for Synthetic Elastomers and Latices. American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.
(4) Leon Talalay, Italian patent No. 528-151, June 10, 1955, assigned to The B. F. Goodrich Co.
(5) The B. F. Goodrich Co., British patent specification 758,622, Oct. 3, 1956.
(6) Goodyear Tire & Rubber Co., chemical division, Akron, O. New Product Bulletin (Mar. 14, 1958).
(7) United States patent Nos. 1,777,945; 1,852,447; 1,994,503; 2,114,275; and others.
(8) U. S. patent Nos. 2,138,081; 2,290,510; 2,432,353; and others.
(9) R. J. Stalter, Goodyear Tire & Rubber Co., Airfoam division, private report (Apr., 1958).
(10) T. H. Rogers, H. H. Heinemann, Rubber World, 130, 4, 503 (1954).
(11) U. S. patent No. 2,594,217.

Effects of Heat and Radiation

(*Continued from page 386*)

irradiation. Methods II and III are more drastic than Method I in the average rate of reducing ultimate elongation to one half the initial value. On the average, all three test methods result in approximately the same reduction in % retained elongation after the 587 x 10^7 ergs per gram exposure for a given compound.

SBR wire insulation compounds and Hycar 1043-SBR 1001 tube stocks showed significantly more radiation resistance than the other compounds. This attests to the inherent good resistance of SBR to radiation damage. The Hycar self-sealing fuel cell liner stocks gained the most overall benefit from the potential antirads Akroflex C and quinhydrone.

In general, the protection afforded by the latter two additives ranged from zero to a threefold increase in the radiation dose necessary to reduce the ultimate elongation by half. The stocks were less well protected at 158° F. than at room temperature, during both irradiation and testing, in the cases where protection occurred.

The separate effects of heat on the rate of radiation damage and on the physical test values do not appear to add in a simple way. It appears that less radiation damage results from the combination of both irradiating and testing at 158° F. than the sum of the separate effects would predict. Therefore, in engineering studies both irradiation and testing should be conducted at the service temperature of interest.

Continuation of this work by Methods V and VI at 158° F. and by all six methods at 212 and 280° F. is in progress to complete this program of research. It is hoped that the overall results will permit approximate extrapolation to combinations of temperature and radiation exposure which are not specifically included in the present program.

New Molding Latex

A new one-part mold making compound using latex has been developed by the Java Latex & Chemical Corp., New York, N. Y. The product, designated Javatex Molding Latex, is a milky-white liquid rubber which is self-vulcanizing. No catalytic agents or accelerators are required for drying or curing molds made with this new material. Application may be made by brush, spray, or hand-dipping, depending upon the nature of the object to be molded and the type of mold to be made. No messy batter mixing is required, according to the company, and molds that are accurate to the minutest detail can be produced.

Molds made with this Javatex Molding Latex are suggested for the manufacture of religious statuaries, toys, novelties, sports equipment, lamps, mannequins, artificial limbs, rubber masks, dolls, artificial jewelry, and a wide variety of rubber, plastic, and ceramic products. The latex vulcanizes rapidly when exposed to air, but it has a long shelf life when kept in a very tight container. Once the mold is made, it may be used over and over, and the company states that it will maintain its original form and fine detail for years. Molds made with Javatex are heat-resistant. This new molding latex is available from the company in pints, quarts, and in gallons, as well as full drums.

Fundamental Control Concepts—I[1]

By MASON E. WESCOTT

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AT THE outset, let us be clear about one thing: we are going to emphasize *concepts,* not *methods,* and certainly not *theory*. We may need to mention these latter, but only if they help nail down a better grasp of concepts.

"Control" is a very broad term which can mean different things to different people in different circumstances. We shall take the position that "control" does not mean *domination* in the absolute sense, when it refers to the management and direction of an industrial process, but rather the exercise of *discrimination* relative to available alternatives in the innumerable action decisions that have to be made daily by those persons who have direct responsibilities affecting the quality/cost ratio of operations. We shall take the further position that control in this sense automatically implies the systematic use of appropriate statistical methods, since this science is just the one man has created for the primary purpose of making intelligent discrimination possible. Whether we like it or not, action decisions have to be made constantly all along the line from product design to product delivery. A higher proportion of *correct* decisions can be made when they are based on facts rather than fiction. It is precisely the business of statistical methods to get the facts in an impersonal way so that "control" in the sense of this discussion can stem from a better *understanding* of the problem.

It would, however, be a mistake to infer that control in *some* meaningful sense cannot be achieved *without* the use of statistical methods. We do not wish to imply that "control" without the use of statistical methods is impossible, or even necessarily ineffective, but we do assert that control through the integrated use of statistical methods can be *more* effective in helping a company to strike a profitable balance between the factors of quality and the factors of cost.

It therefore follows that the concepts with which we shall be concerned are essentially statistical concepts. They provide fundamentals whose elaboration leads to more detailed consideration of specific techniques than would be appropriate for presentation in this paper. What we want to do here is to concentrate on *ideas* which can open up new ways of thinking about old problems. The details of methods to implement these key ideas must be left for subsequent follow-up.

The Concept of Variation

The beginning of wisdom is the recognition that variation is the key phenomenon in every avenue of human experience. In particular, it is the very heart of the *necessity* for control in *any* sense so far as an industrial operation is concerned. Under any repetitive operation variation will be certain to exist if only we measure fine enough. We can't achieve perfection; nor do we need to. With every product there is associated some level of perfection. Dr. Juran has called this appropriately the "quality of design." Consider, for example, such a simple thing as a can opener. We can buy can openers all the way from a few cents to several dollars. The difference is in

[1]Presented before the American Society for Quality Control, Chemical Division, Buffalo, N. Y., Oct. 2, 1958.

The Author

Mason E. Wescott, professor of applied statistics, University College, Rutgers University, obtained his B.S. degree from Northwestern University in 1925 and his Ph.D. in 1939 from the same university.

Dr. Mason was employed in the mathematics department of Northwestern until 1928, after which he became assistant statistician, Public Safety Division, National Safety Council. He returned to Northwestern in 1930, where he became an assistant professor of mathematics. He has had his present position at Rutgers since 1952.

He is a member of the American Statistical Association, Institute of Mathematical Statistics, American Society for Quality Control, and Acacia fraternity. Dr. Mason is a fellow, founding member, and 1956 Shewhart Medalist of ASQC. He is also chairman of the editorial board of *"Industrial Quality Control"* the ASQC journal.

Fundamental Control Concepts

Quality control and the use of mathematical statistics in industry have been known for at least 25 years and have had increased emphasis during and since World War II, particularly for the last five to ten years.

Although RUBBER WORLD has had articles and other material on these subjects over the past several years, this article by Dr. Wescott is the first of a series which will attempt to provide a review of the fundamentals and which will then include some reports from companies in the rubber and supplier industries on the use of these techniques.

As Dr. Wescott states in this article, it would be a mistake to infer that control in some meaningful sense cannot be achieved without the use of statistical methods.

"We do not wish to imply that 'control' without the use of statistical methods is impossible, or even necessarily ineffective," he adds, "but we do assert that control through the integrated use of statistical methods can be more effective in helping a company strike a profitable balance between the factors of quality and the factors of cost."

Dr. Wescott reviews the concepts of variation, variation pattern, the control chart, scientific acceptance sampling, and defect prevention in a most interesting and informative manner in this first article.—EDITOR.

the quality of design—the level of perfection aimed at by the different designs.

Once the level of perfection has been set for a product by the design specifications, there enters the problem of making the product, item by item, to conform to these specifications. This is what Dr. Juran has also appropriately called the "quality of conformance to design." We may be perfectly willing to settle for a 25¢ can opener rather than one that costs $3.50. But we want it to be a *good* 25¢ can opener—not a defective one!

Right here is where the ugly specter of variation rears its head. Raw materials vary in the characteristics important to their intended use. Human skills vary in their capacity to deliver consistent performance. Machines and equipment vary in the most surprising and unexpected ways.

One commonly hears more or less polite versions of the plaintive phrase, "You *can't* control it—there are just too many variables!"

Well, bless your heart, friend, that is just the situation on which the methods of statistics thrive! If there were no variation in product quality, there would be no need to try to control it and therefore no need of statistics. Statistical science provides the very tools that have been created to help understand, and therefore to help control, the inevitable variation that arises whenever we attempt to make two or more things alike.

So the existence of variation in industrial operations must be accepted as a perfectly natural element that will always be present. Statistical quality control (SQC for short) is based on the proposition that you can't eliminate variation, but you can control it. Thus we learn to live with variation, not as some mysterious, evil, intolerable, haphazard handicap, but rather as an ever-present, natural consequence of repetitive operations which obeys certain fundamental laws of nature that can be discovered and put to use to help control the variation within predictable limits. This leads to our second basic concept.

The Concept of Variation Pattern

How long do you suppose a game of craps would run if every pass of the dice turned up the sum seven? Variation from pass to pass even with a pair of dice is required to make the game of craps possible.

Take a pair of fair dice—or better still, take three fair dice—and roll them at random for 100 or 200 trials, recording at each trial the sum shown by the three dice. At any toss, it can't be less than 3 or more than 18. If you tally the number of 3's, 4's, etc., up to 18's that you get, you will discover an interesting and fundamental fact: the variation in the results of tossing three dice follows a recognizable pattern. Most of the tosses will show sums from 9 through 12, with rapidly diminishing frequencies of occurrence as the sum drops from 9 to 3 or increases from 12 to 18. There should be a recognizable, bell-shaped pattern to the variation in dice totals over the range 3-18. It won't be perfect—we don't expect perfection—but it won't be haphazard either: there will be a clearly observable pattern.

Now do the same thing with a set of 50 or 100 or 200 (the more the better) measurements of some product characteristic in your plant such as a dimension, or a weight, or an electrical resistance, or a time in seconds, or a per cent. concentration, or what have you. Get your supply of items at random from current operations, and tally up your results just as you did for the dice.

Once again you will discover that over the range

from the smallest to the largest observed measurement there is a recognizable pattern for the variation in these measurements. This pattern may or may not resemble the one observed for the dice experiment. The essential point is that there *will* be a variation pattern if enough items chosen at random are measured carefully.

One reason the variation pattern may differ from that associated with the dice data is that in randomly tossing three dice most of the variation can be regarded as the result of just chance causes. By just grabbing a lot of measurements from a production process we cannot be sure that most of the observed variation is the result of only chance causes—different sets of operating conditions may have been present during the span of time over which the things we measured were being made.

But the concept we want to establish here is that, in any event, we can obtain a variation pattern by the simple process of tallying up the frequencies with which the several measurements in our sample are observed. Many useful and helpful results have been obtained by plant personnel through nothing more complicated than the simple operation of ordering a set of observed data by this tallying technique. The result is called a "frequency distribution", and its graphical counterpart is called a "histogram." A histogram is just a picture of a variation pattern, and simple histogram studies have proved to be a fruitful way to discover what is happening in a production process.

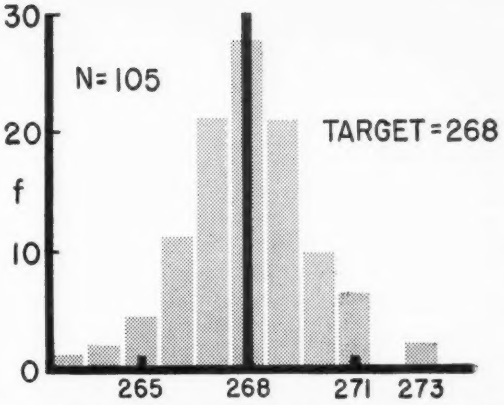

Fig. 2. Histogram of chemical plant data on variation of concentration of a chemical in a process

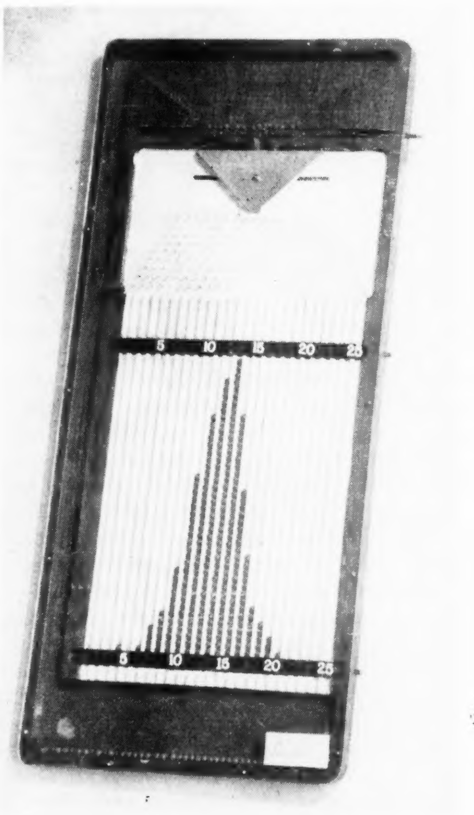

Fig. 1. "Quincunx" device for building up histogram picture of variation pattern due to chance causes

A simple device for quickly building up a histogram picture of a variation pattern resulting when just chance causes are responsible is the "quincunx" shown in Figure 1. This device does a good job of simulating what the variation pattern for a production process can be expected to look like when only chance causes are responsible for the variation.

The device operates by dropping a bead from the hopper at the top into a panel consisting of ten rows of staggered pegs. How the bead will pass through this maze of pegs is governed only by chance. It eventually drops into a slot which carries a number at the bottom of the slot, as shown in Figure 1. When this operation is repeated a large number of times, we get a variation pattern like that in the picture. We may think of the slot numbers as measurement values for some quality characteristic, the maze of pegs as the various factors in the process that have an influence on what value a "unit" of production will finally possess, and the passing of the bead through this maze as corresponding to the "processing" of a unit of product.

Figure 2 shows the histogram for some actual plant data on chemical concentration. Note the similarity between the variation patterns in the two cases. Each of these histograms is a sample approximation to an ideal or theoretical variation pattern of fundamental importance in statistics, viz., the normal curve or normal distribution or normal probability model as it is variously called.

Figure 3 pictures a normal curve model made out of plastic sheeting and used for demonstration purposes in training classes. Note the symmetrical, bell-shaped contour of the curve.

The normal curve is the model that idealizes the variation pattern when a large number of small, independent, chance causes operate in a random manner.

An important property of this model may be de-

scribed in terms of the vertical lines in the picture that divide the area under the curve into three panels on each side of the line through the peak of the curve. The width of each of these panels is measured by what is called the "standard deviation"; the line through the peak locates the average or target value for the distribution. The zone marked out by the lines at one standard deviation above and below the average includes 68% of the total area under the curve. The zone marked out by the lines at two standard deviations above and below the average includes 95.4% of the total area. The zone marked out by the two dowel pins at the extreme right and left edges of the curve includes 99.7% of the total area.

For an observed distribution that resembles this model as closely as those shown in Figures 1 and 2, we can calculate the average and standard deviation and make some useful statements. We can say that the variable in question appears to be approximately normally distributed. We can say that we can expect about 68% of the variation in this variable to be within one standard deviation of its average value, about 95% of the variation within two standard deviations of the average, and practically all of its variation to be within three standard deviations of the average.

There are numerous other predictive statements that can be made about a repetitive operation whose variation pattern resembles the normal curve, but we shall not pursue these possibilities here. Our point is that variation patterns in the form of frequency distributions or histograms are easy to make from available data, and that when the pattern appears to resemble the normal curve, we can use the properties of this model to make a variety of useful statements about the way in which we can expect the variable in question to be distributed.

Information of this sort can go a long way toward giving a useful, factual understanding of what a process has been doing with respect to some measurable characteristic of the product involved. With such a

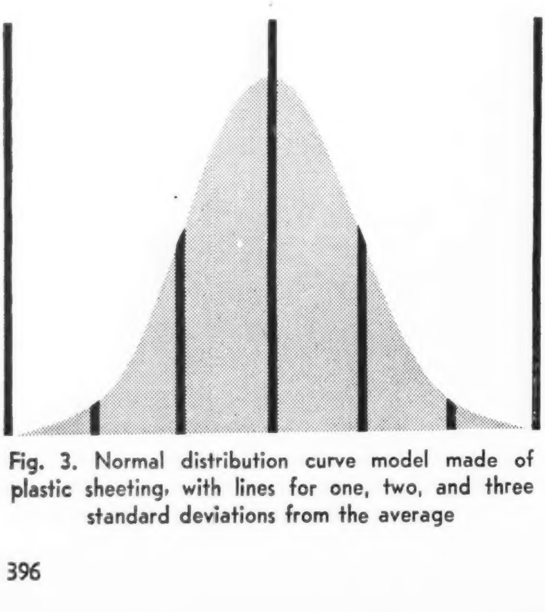

Fig. 3. Normal distribution curve model made of plastic sheeting, with lines for one, two, and three standard deviations from the average

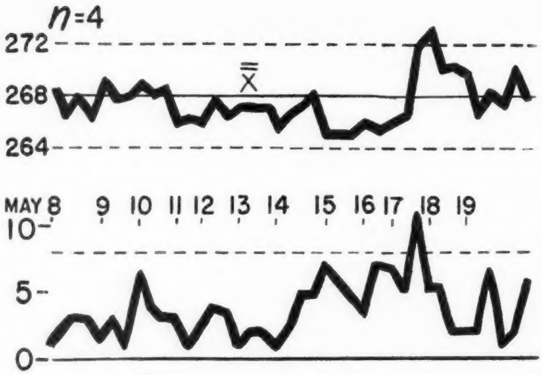

Fig. 4. Typical control chart for average and range values for a chemical process control

picture of the variation pattern associated with the process, questions of control take on a realistic aspect with respect to the matter of product conformance to design requirements.

We have stated that variation always exists and that it is possible to discover a pattern for it. We have indicated the kind of pattern that may be expected when chance causes operate in a random manner. We have implied that variation is often due to causes other than chance. In SQC it is common to speak of these sources of non-chance variation as "assignable causes."

As a practical matter of prime importance, how do we distinguish variation due to assignable causes from that due to chance?

This leads us to our next concept.

The Concept of a Control Chart

A control chart is a simple graphical tool for helping us distinguish between variation due to causes it would be unprofitable or impossible to identify—chance causes, for short—and variation due to causes it would be profitable and is usually very possible to identify—the assignable causes, for short. It is the discovery and the elimination of these assignable causes of variation that spell the difference between a controlled process and an uncontrolled process.

There are two kinds of control charts in SQC:

(1) those that are used when the inspection test actually measures some characteristic, such as a dimension, and

(2) those that are used when the inspection test merely classifies items as good or bad, such as would be done with a go, no-go gage; or when the inspection test merely counts the number of defects per unit of product, such as recording the number of defects observed on an assembly inspection.

Charts that serve the requirements of (1) are called "measurement" or "variables" charts; the average and range (or $\overline{X}$ and R) charts are the most widely used charts of this type.

Charts that serve the requirements of (2) are called "attribute" charts; the fraction defective (or p) chart and the number of defects per unit (or c) chart are perhaps the most widely used charts of this type.

What *any* control chart does is to reflect process variations in some quality characteristic over a time scale. This is accomplished by taking relatively small samples from the process itself at fairly regular, successive time intervals. Data from these samples are plotted on a chart whose base line is essentially a time scale. Thus we get a running record, visual in character, that shows how the process is varying with respect to time. This is of immense practical value because we can spot, while the process is operating, such things as shifts in process level and trends for better or for worse in process performance.

But we get more than this from a control chart. Every such chart, after a few plottings, can have put on it the overall level or average performance of the process with respect to the particular quality characteristic being studied. This appears on the chart as a horizontal line drawn in at the average value of all the points plotted. It is called, of course, the "center line" for the chart.

Finally, and most important of all, every control chart can have put on it one or two lines called "control limits." These lines usually appear as dotted lines parallel to the center line. The important thing is that the formulas used to place these control limits on a chart are based on sound probability laws. Once they are on the chart we have a band or zone established by process performance—not by edict!—such that points which form a random pattern within this zone may be taken to represent sources of process variation that are inherent in the repetitive nature of the operation—chance variation is the usual designation. Points that fall outside this zone almost always represent variation in the process that is not due to chance causes. We say such variation represents the presence of some "assignable cause" (or causes) which it would pay to investigate and try to eliminate.

It is also very useful to watch the pattern of variation within the control limits. Too many successive points above or below the center line, even though still within the control limits, represent a shift in the process level which it may be desirable to correct before any plottings fall outside the control limits. Similarly, a succession of points, each one higher (or lower) than its predecessor, indicates a trend toward either better or worse quality and calls for some appropriate action accordingly.

The control chart thus makes it possible to distinguish with a high degree of certainty between variation due to chance and that due to non-chance causes. It serves as a guide to action on the process. By watching the pattern that develops on the chart as successive points are plotted, we know when to leave the process alone and when to take corrective action. Defective work can often be prevented in this way, thus reducing or altogether eliminating sorting inspection after a whole lot has been produced. Operating personnel in production and inspection have in the control chart a visual record of what the process is doing as the job is being run. The many quality/cost advantages that flow from such an on-the-spot quality accounting record as the control chart gives are obvious.

Figure 4 is an example of a typical control chart. The quality characteristic covered by this chart is chemical concentration. Data are from the same process as that from which the histogram in Figure 2 was made. But whereas the histogram shows only what the process *had done* after 105 samples were tested, the control chart shows what it *was doing* from May 8-19. Periodic samples of four determinations each were made during this time. The upper panel shows the variation in the averages of these successive samples; the lower panel shows the variation in the range within these samples, i.e., the difference between the highest and lowest reading in each sample of four.

Note that on each panel one point is outside the control limit lines. Some unusual source of variation—some assignable causes—were present in the process at these times to push the average of a sample of four so far above its target value of 268 and to cause such a wide spread between the highest and lowest value in a sample of four as is indicated by the one very high range plotting. Points such as these call for investigation and corrective action.

Note also on the average chart the long run of points all below the center line from about May 11 through 17. Even though these points all fall within the control limits, such a pattern is clear-cut evidence of a shift in process level which it might be desirable to correct. On the range chart there is also some evidence of a trend up from about May 14-18. This would mean that samples of four were tending toward less and less stability in concentration over this period—a situation well worth investigating even though all but the last point fall within the control limits.

Whether or not the analysis we have just made and the actions we have suggested were actually taken in this particular case is beside the point we are trying to make with this example: viz., that a control chart provides a running record of what a process is doing as it goes along and can therefore be used as a guide for action. Unless appropriate action as indicated by the chart *is* taken, there is no point in bothering to keep the chart—one might as well set up a good traffic light at a busy intersection and then proceed to pay no attention to the signals it flashes.

Charts such as these are called "control" charts for the very obvious reason that *control* of a process is exactly what they make possible when they are *used* as a guide to action. They belong *with* the process as a current record of what it *is* doing, so that the operating people can keep "on top of the job" and leave the process alone or take corrective action, as called for by the variation pattern that develops on the chart.

(*To be continued*)

NEWS of the

RUBBER WOR

Rubber Manufacturers Association annual meeting speakers emphasize that all signs point to continued business recovery in the rubber industry in 1959. Jules Backman, New York University economics professor, is optimistic regarding rising output per manhour in all industry which will make it possible to limit wage inflation for the first time in years.

Commerce Department will now permit shipment to Soviet bloc countries of natural and butyl rubber, Kel-F fluorinated elastomer, and high-pressure drilling hose. Government officials take the position, however, that big-volume trade with the Soviet bloc is not likely in the near term future.

Labor Department minimum wage hearings have produced a \$1.54 to \$1.93 hourly rate, the former suggested by the tire manufacturers and the latter by the AFL-CIO United Rubber Workers. Final decision depends on Labor Secretary Mitchell.

United Carbon Co. has elected R. W. French, president and director of the parent company, president of its United Carbon Co., Inc., and executive vice president of its United Rubber & Chemical Co. A. G. Treadgold was chosen senior vice president of United Carbon Co., Inc.; and H. E. Norrick senior vice president of United Producing Co. John H. McKenzie is now vice president of United Carbon Co., Inc., and of United Rubber & Chemical, and a director of all three companies.

Firestone Tire & Rubber Co. has promoted John L. Cohill to vice president, special assignments; L. J. Campbell to vice president of all company subsidiaries except tires; and Mario Di Federico to Steel Products Co. president. J. J. Robson becomes director of tire engineering and development.

Enjay Co. has elected John E. Wood, III, president, replacing O. V. Tracy, who will now devote full time to being vice president and director of Esso Standard Oil Co. Karl J. Nelson, is now vice president, sales; Harold J. Rose, vice president, products management; and A. Donald Green, vice president, new project development, of Enjay.

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MEETINGS and REPORTS

Fifth Joint Army-Navy-Air Force Elastomer Conference in Dayton

Approximately 250 scientists from three military services, universities, and industrial research laboratories met in the Hotel Miami, Dayton, O., October 15 to 17, for the Fifth Joint Army-Navy-Air Force conference on Elastomer Research and Development. As with past Conferences, the objective was to coordinate research and development programs among the Services and, at the same time, enlist the aid of top academic and industrial talent in the solution of critical problems.

The Fifth Conference included four sessions. The first session consisted of opening remarks by Col. James C. Dieffenderfer, chief, Materials Laboratory, Wright Air Development Center, and program statements by J. R. Townsend, Office of the Assistant Secretary of Defense, Research & Engineering, and in keeping with recent trends toward international cooperation among friendly nations on technical problems, also by H. Warburton Hall, Ministry of Supply, London, England. Walter R. Kirner, program director for chemistry, National Science Foundation, was scheduled to discuss the "Program of the National Science Foundation," but was unable to attend the Conference. His statement will be published in the report of the meeting, which will also include publication in full of all of the 36 papers presented at the other three sessions.

The second session was devoted to the Army's Elastomer Program and was entitled "Behavior Evaluations of Elastomers under Unusual Service Environments." The chairman for this session was J. C. Montermoso, chief, Elastomer Branch, Quartermaster Research & Development Center, Natick, Mass. The third session covered the Navy Elastomer Program and was entitled "Basic and Applied Research" and had as its chairman J. H. Faull, Jr., Office of Naval Research, Washington, D. C. The Air Force Elastomer Program was covered in the fourth and final session, and the subject here was "New Polymers and Their Prospects." A. M. Lovelace, Polymer Section, Material Laboratory, WADC, was the chairman for the final session, with C. S. Marvel, University of Illinois, Champaign, Ill., presiding.

E. R. Bartholomew, Materials Laboratory, WADC, general chairman for the meeting, first welcomed those present. Colonel Dieffenderfer, in discussing the aims and purposes of the Conference, said that two prime objectives were obtained. First, a unified program of elastomer research and development has been maintained among the military services without unnecessary duplication of effort, and, second, periodic reviews of military elastomer programs have made it possible to enlist the aid of top technical talent from the academic and industrial world in the solution of critical elastomer problems. The Colonel then introduced Mr. Townsend who spoke on "Basic Research—The Frustrating Question."

Basic Research

Mr. Townsend pointed out that the scientist or technologist has no difficulty in meeting routine demands on his knowledge and reasoning powers, but that every now and again there comes along an unexpected challenge that utterly flabbergasts him. How he reacts to this challenge—the eagerness, the vital energy, the imaginativeness he is able to summon up—will determine whether he permits himself to remain frustrated, or whether he can convert the challenge into another forward step in technological progress, it was added.

For the most part, research in rubber has tended, in the past, to be linked up with pressures of one kind of emergency or another, he said. Despite the fact that the rubber molecule presents the scientists with a frustrating and compelling challenge, there has been an air of leisureness about research in this field, according to Mr. Townsend. Remarkable progress in rubber research has been achieved when the pressure was on, however; and the instances of methyl rubber produced by German scientists during World War I, the development of Thiokol polysulfide rubbers, neoprene, and nitrile rubbers in this country prior to World War II, and the GR-S program were cited in this connection.

Even though the rubber industry may be expected to spend 100 million a year on product research, this very substantial effort will not supply the needs of military weapons for improved elastomeric materials, and for this reason government sponsorship of research on improved elastomers for special military uses seems to be inescapably the answer.

Scientific research in this country consists of three separate scientific efforts: one is science for its own sake, the second is scientific effort aimed at economic reward, and the third is research sponsored by the Federal Government, Mr. Townsend said. Industrial research having as its purpose the evolution of new and profitable products must be increasingly supplemented by government-sponsored research to produce catalytic products and ideas needed by our society that are not themselves profitable.

The objectives of research from a national point of view, according to Mr. Townsend, should be as follows: (1) to make ourselves militarily secure; (2) to continue the rise in our standards of living and human well-being; (3) to demonstrate by our achievements and discoveries that a free socitey is better capable of discovering and using the facts of nature than is an authoritarian society; in this last sense, science becomes literally an end in itself.

Research in the incredibly complex rubber molecule—and in the extremely difficult field of elastomers in general—can contribute toward all three objectives, this speaker concluded.

Other Program Details

The planning committee for the Conference included Drs. Faull and Montermoso and Irving Kahn, Watertown Arsenal; J. M. Kelble, WADC; and the late T. A. Werkenthin, Bureau of Ships.

B. S. Garvey, Jr., Pennsylvania Industrial Chemicals Corp., read a short tribute to Mr. Werkenthin whose death occurred on October 7. A short period of silence as a tribute to Mr. Werkenthin and his contributions to the field of elastomer research was observed.

On the evening of October 15 an informal dinner was held at the Hotel Miami for those attending the Conference. It was preceded by a cocktail party in the Sky Terrace Room.

Army Elastomer Program

Abstracts of papers presented before the session devoted to the Army's Elastomer Program follow:

"The Evaluation of Elastomers for High-Temperature Aircraft Tires," Glenn Alliger, Firestone Tire & Rubber Co., Akron, O.

The work at Firestone on high-temperature properties of elastomers has been divided into two phases. First, it was necessary to make a comprehensive survey of properties of commercially available elastomers by means of special laboratory tests. Information obtained from these studies classified the polymers with respect to their properties at elevated temperatures. This information is, however, of limited value in predicting performance in an end-product such as an airplane tire. For the second phase of this work it was therefore necessary to study the processing and fabrication of selected elastomers into a preliminary tire assembly, with the object of eventually evaluating the performance of these elastomers in the various tire components at temperatures up to 550° F.

Evaluation of available elastomers for such properties as tensile strength, elongation, permeability, resilience, and aging resistance at temperatures up to 550° F. was made with equipment designed and built specifically for these studies. Past experience with heavy-duty tires indicates that both the strength retained by the compounded elastomers in the tire at operating temperatures and the resistance of the elastomer to heat aging are critical factors determining tire performance. Therefore, of some 20 elastomers tested, two were selected for tire studies, Firestone's butadiene/methyl methylacrylate, BD/MMA, 70/30 copolymer (cured with barium hydroxide), and one of the new high tensile strength silicone rubbers, the former because of its high hot tensile strength, the latter for its exceptional aging resistance. Steel wire, being the only available material for tire cord which will withstand temperatures above 400° F., required means of adhering the selected tire polymers to wire at temperatures up to 500°, and these methods had to be developed.

Considerable progress in solving tire construction problems peculiar to these special elastomers has been made, and further work of this nature is being done which, it is anticipated, will make it possible to evaluate adequately the behavior of promising elastomers under conditions closely resembling those to be expected in high-temperature service.

"Determining Compatibility of Elastomers with Liquid and Gaseous Rocket Propellants," John H. Baldrige, Connecticut Hard Rubber Co., New Haven, Conn.

Apparatus and procedures are described for the evaluation of elastomers and plastics after contact with a number of liquid or gaseous rocket propellants at temperatures to 400° F. The propellants being considered are inhibited red fuming nitric acid (IRFNA), anhydrous hydrazine, unsymmetrical dimethyl hydrazine (UDMH), JP-X fuel mixture (UDMH/JP-4:40/60),

Col. James C. Dieffenderfer

ethylene oxide, n-propyl nitrate, gaseous fluorine, chlorine trifluoride, 90% hydrogen peroxide, di-isopropenyl acetylene (DIPA), and nitrogen tetroxide.

Immersion vessels and bombs used for immersion tests plus apparatus for exposure of elastomers and plastics to chlorine trifluoride and gaseous fluorine, are described in some detail. Where possible, such tests have been carried out in laboratory glassware, and standard testing procedures have been used, but modifications have been required as a result of the potential hazards involved.

Apparatus for measuring permeability to propellants is described, and the merits of available methods are discussed. A simple apparatus for the measurement of impact sensitivity of elastomers after exposure to some propellants has been designed, to allow an estimate of this quantity.

Progress to date in the development of elastomers resistant to the propellants listed above is reviewed.

"Selection of Rubbers for Use with 90% Hydrogen Peroxide," R. E. Morris, R. R. James, and R. Chow, Mare Island Naval Shipyard, Vallejo, Calif.

The expanding uses of 90% hydrogen peroxide have created a need of rubber hose, seals, and diaphragms which are compatible with this very strong oxidizing agent. Other laboratories have made surveys of rubbers for use with 90% hydrogen peroxide, but their rubber samples were proprietary items containing unknown compounding ingredients which might have influenced the results. In the present investigation pure-gum vulcanizates of various rubbers were tested wherever possible. Twenty-nine rubbers were tested in pure-gum stocks. They consisted of the following: natural, styrene-butadiene, acrylonitrile-butadiene, vinylpyridene-butadiene, butyl, brominated butyl, chloroprene, chlorosulfonated polyethylene, acrylic, urethane, silicone, fluorobutyl acrylic, and perfluoro rubbers. Tests were also performed on 12 silicone rubbers compounded with fine-particle silica, and 26 silicone rubbers and one fluorosilicone rubber compounded by the manufacturers of these rubbers.

The test procedure consisted of immersing small specimens of the vulcanizates into 90% hydrogen peroxide for seven days at 151° F., then determining the loss of active oxygen in the peroxide and noting the deterioration of the specimens.

It was found that most of the silicone rubbers and the fluorosilicone rubber were visually unaffected by this treatment, and some of these rubbers caused relatively minor decomposition of the hydrogen peroxide. All of the other rubbers were visually deteriorated.

The target value for decomposition of hydrogen peroxide was 15%. This value was seldom obtained even with the best silicone rubbers unless they had first been deactivated by a previous immersion into 90% hydrogen peroxide for seven days at 151° F. The losses of active oxygen obtained in tests performed at different times on supposedly replicate specimens were often in poor agreement.

All test specimens were vulcanized in a mold between sheets of aluminum foil in order to obtain rubber surfaces with minimum activity toward hydrogen peroxide. The use of foil is not practical, however, when molding items such as O-rings. A Teflon[1] coated surface was found to be best for this purpose.

"Effect of Gamma Radiation on Compression Set of Various Rubbers," R. E. Morris, R. R. James, and F. Caggegi, Mare Island Naval Shipyard.

It is expected that in future applications of nuclear energy, mechanical devices containing fluids will be in the radiation field. The fluids may be compressed gases, coolants, lubricants, or hydraulic fluids. Rubber gaskets and packings such as O-rings are convenient means for sealing fluids; therefore information on the service life of these items in a radiation field is desirable.

Considerable information has been gathered by various investigators on the deterioration of rubber vulcanizates exposed to nuclear radiation, but in most instances only changes in tensile properties and hardness have been measured. The sealing ability of a gasket or packing is also influenced by the tendency of the rubber to undergo stress relaxation and compression set. Compression set is the easier of these latter properties to measure and was therefore utilized in a survey of rubbers to determine their suitability for use in seals exposed to gamma radiation.

Test specimens, ¾-inch in diameter and ½-inch in thickness, were pre-

[1] Polytetrafluoroethylene, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

pared from various rubbers. All except a silicone rubber and a fluorosilicone rubber were compounded to meet a hardness requirement of 70 ±5 Shore A hardness and a stringent hot compression set requirement. The latter rubbers were used in the compounded form provided by the manufacturer.

The test specimens were compressed 30% in aluminum devices. Replicate compressed specimens were subjected to 10^7, 10^8, and 10^9 roentegens of gamma radiation in a water-filled canal. Replicate compressed specimens, not subjected to radiation, were used as controls.

All of the specimens had approximately 100% set after exposure to 10^9 roentgens. There was a considerable variation between the sets after exposure to 10^8 roentgens. They ranged from about 60% to more than 100%. Specimens prepared from a styrene-butadiene rubber and from a urethane rubber had the least set; whereas specimens prepared from a silicone rubber, a fluorosilicone rubber, and a perfluoro rubber, respectively, had the greatest set. Five parts of certain antioxidants in the vulcanizates were found to reduce somewhat the set of the specimens prepared from natural rubber, the styrene-butadiene rubbers, and the acrylonitrile-butadiene rubbers.

All of the specimens had less than 100% set after exposure to 10^7 roentgens. The sets ranged from about 15 to 90%.

"Evaluation of Seals Having Simultaneous Resistance to Oil, Water, and Abrasion," W. B. Lew, Puget Sound Naval Shipyard, Puget Sound, Wash.

An evaluation of three rubber blade seal designs was conducted under simulated test conditions simulating the environment within the controllable pitch hub assembly of LST (landing ship tanker) Class 1156 vessels. The blade seal normally functions under static conditions, but whenever the propeller is being adjusted for the forward or astern position, the blade seal is in sliding contact with a bronze retainer plate that rotates through approximately a 27-degree quadrant. The seal system is operated to retain Symbol 9250 oil within the propeller hub assembly, and to prevent sea water from infiltrating inward.

The investigation comprised a study into the functional design of the seal and also rubber compounding studies. The blade seal designs resembled somewhat a "hoop" ring, approximately 14 inches I.D. and 16 inches O.D. by 0.375-inch height. Cross-section configurations and actual dimensions of each seal differ for each design. A functional design was developed utilizing an all-rubber-type blade seal as compared to the metal-insert type of blade seal.

Compounding studies on nitrile and urethane rubbers were conducted to obtain the optimum properties with respect to sealability, and resistance to oil and water. Abrasion resistance was considered a secondary requirement. Urethane rubber was inferior to nitrile rubber. Properties of sulfur and dicumyl peroxide-cured nitrile rubber were compared; and a sulfur-cured nitrile rubber compound was selected and used for compression molding the blade seal.

The all-rubber blade seal performed satisfactorily under different simulated test conditions including: (a) rotation between two steel plates and (b) rotation between two steel plates with the distance between the plates varying 0.010-inch every 1.5 seconds.

"Testing of Fluid Seals for Extreme Environments," R. J. Dunsmoor and F. W. Tipton, Seattle Division, Boeing Airplane Co., Seattle, Wash.

The effect of environment on physical properties and sealing ability is discussed along with the use of tests which are designed to show the effects on the material such as brittle point, swell, temperature-retraction, and coefficient of thermal expansion. Significant is the fact that normally measured "physical properties" of elastomers have not given a direct relation to the sealing ability of fluid seals. A few do give an indication how a material will satisfy individual requirements of a certain seal type. Stress relaxation tests indicate the forces exerted by a low-pressure static seal. Surface hardness tests indicate conformability to a surface. Stress-strain curves, abrasion, and tear resistance tests are all applicable to dynamic seals where extrusion, cutting, and wear are the main causes for failure.

Because the physical properties give only an indication of a material's sealing ability and also because the mechanical conditions imposed on a seal vary considerably, it is emphasized that functional tests are required to evaluate completely a material as a seal. The functional tests should be run under the environments in which it is expected that the seal will be used. The final evaluation of a seal material will only come when it is used as a component in an operating system. If, however, adequate physical and functional testing has been done, the seal will have an excellent chance of operating satisfactorily.

H. Warburton Hall

"Evaluation of Elastomers in High Energy Fuels." R. E. Headrick, Wright Air Development Center, Wright-Patterson Air Force Base, Dayton.

A few years ago it was recognized by those designing and developing new aircraft propulsion systems that the limitations of the hydrocarbon fuels were being approached, and that if speed, altitude, and range of our aircraft were to be significantly improved, a new and more powerful fuel had to be developed. The Navy Department developed a boron-type high energy fuel that at least theoretically had great potential and the Navy and the Air Force launched a cooperative program to produce and develop such fuels.

Unfortunately, the new fuels brought new problems, not the least of which was materials compatibility. Since the introduction of these high energy fuels, many organizations have been concerned as to how they may be handled, and what type of test procedures can be used. Test procedures developed under direction of the WADC Materials Laboratory for evaluation of elastomeric materials in high energy fuels are presented in this paper.

Both HEF-2 and HEF-3 are very toxic and flammable under conditions necessary for high-temperature testing. The important points for the evaluation of elastomers in HEF are as follows: (1) Before any test work is started, a fire extinguisher, gas mask, and protective clothing should be provided the worker. (2) All aging tests should be performed under an enclosed hood. The high-temperature studies should be performed in an aluminum block heater located under the hood. (3) Hot fuels should not be exposed to air because of the fire hazard involved. (4) All high-temperature testing should be performed in an apparatus so arranged that an inert atmosphere can be maintained over the fuel during the test, which apparatus will withstand the pressure developed.

Only the fluorinated elastomers have been found resistant to HEF to date. One of the most resistant compounds for use with HEF is made from Viton A-HV[2] and is cured with dimethylbenzylamine.

"Methods for Studying Behavior of Elastomers in Aircraft Fuels at High Temperatures," R. G. Spain and L. C.

[2] Copolymer of vinylidene fluoride and hexafluoropropylene, Du Pont elastomer chemicals department, Wilmington.

Smith, Wyandotte Chemicals Corp., Wyandotte, Mich.

Conventional tests to determine the resistance of elastomeric compounds to various aircraft fuels employ a comparison of original physical properties to those measured after aging in the fuel. Hence, the data reflect the ability of an elastomeric compound to recover from severe environments, but is not necessarily indicative of properties at use conditions.

Accordingly, three testers have been developed to determine physical properties at simulated use conditions. As test temperatures are generally above the boiling points of aircraft fuels, the determination of physical properties must be made on specimens enclosed in pressure vessels. This requirement necessitates the use of novel methods to apply and determine forces as conventional mechanical methods are inapplicable owing to the high and inconstant frictional forces encountered with sealing devices.

The first two testers have the force sensing devices mounted in the pressurized fuel containers, with force applied to test specimens determined as a function of (1) pressure and (2) deformation of a proving ring-transformer assembly. The third tester relies on a scheme in which force is applied magnetically to a specimen in the completely sealed fuel container.

Data are presented to illustrate the differing conclusions based on conventional and high-temperature determination of the physical properties of elastomeric compounds.

"Compatibility of Elastomers with Explosives," Mrs. M. C. St. Cyr, Picatinny Arsenal, Picatinny, N. J.

The majority of elastomeric compositions do not affect the reactivity of explosives. Polysulfide elastomers cause excessive reactivity of PETN (Pentaerythritol tetranitrate) and PETN containing explosives and are therefore prohibited for use with these explosives. Many butadiene-acrylonitrile elastomeric compositions cause excessive reactivity of a variety of explosives.

Saturated elastomeric compounds resist attack when in direct contact with explosives, but unsaturated elastomers are degraded by aromatic nitro compounds. Polar elastomers are softened by contact with nitroglycerine.

"Elastomeric Binder Requirements for Solid Propellants," Thor L. Smith, California Institute of Technology, Pasadena, Calif.

The current interest in solid propellants for high-performance rocket motors stems largely from the development of castable composite propellants which can be case-bonded in thin-walled motor cases. Such propellants are usually prepared by first dispersing a finely divided inorganic oxidizer in a polymerizable liquid fuel. This dispersion or paste is cast into a metal motor case around a centered mandrel. The dispersion is then cured at a moderate temperature to produce a rubber-like propellant grain bonded to the motor case.

J. R. Townsend

For such applications, the bonded propellant grain must be able to withstand moderately large deformations under widely differing strain rates and often over a wide temperature range. These deformations are primarily tensile and occur both during temperature cycling, due to the unequal thermal expansion coefficients of the propellant and metal case, and during motor ignition which leads to a rapid pressurization and thus to an expansion of the propellant grain and motor case. The propellant shear strength and modulus can be low and need only be sufficiently large so that flight acceleration forces do not crack the grain or deform it sufficiently to modify appreciably the internal ballistic properties. For similar reasons, the propellant grain must not creep excessively during prolonged storage.

These and related propellant requirements indicate that the ideal elastomeric binder should have a low glass-temperature, should exhibit high elongation over a wide temperature range, should not crystallize spontaneously during storage at any temperature, and should be cross-linked, preferably through stable primary valence bonds. The uncured binder material should be a liquid which cures without evolution of gaseous products and with minimum heat release and shrinkage. Also, the binder should dissolve little or no oxidizer and should be chemically stable for long periods of time in intimate contact with the oxidizer.

Other factors to be considered in weighing the relative merits of potential binders are their oxygen balances, viscosities prior to cure, and densities. These factors determine largely whether or not a castable propellant can be prepared which has optimum ballistic performance as well as adequate mechanical properties.

Propellant mechanical properties, however, depend not only on the properties of the binder itself and the volume % of oxidizer, but also they depend on the adhesion and other interactions between the binder and oxidizer particles. The binder should adhere well to the oxidizer, and when unfilled, it should have a low modulus and should deform enormously under small stresses; otherwise the adhesive bonds between oxidizer particles and binder may fail when the propellant is deformed only slightly.

"Investigation of O-Rings for Cylinder Liners of Diesel Engines," S. A. Eller and A. A. Stein, New York Naval Shipyard, Brooklyn, N. Y.

O-ring gaskets used to seal cylinder liners of diesel engines are subjected to the following severe service conditions: (1) They must seal against water at a temperature of 190° F. and pressure of 60 psi. (2) They are compressed for long periods of time during which they may be in both active and inactive (stand-by) service.

Failure of these gaskets cannot be tolerated in service because of the tremendous expense involved in replacing them. This cost is estimated to be $10,000 for a 16-cylinder engine.

The suitability of three neoprene, five nitrile, and two silicone rubber O-ring gaskets for use in diesel engines was investigated with the compression stress relaxation apparatus developed by the Material Laboratory and now described in ASTM[3] Method D 1390. Specimens cut from the O-rings were cemented in aluminum blocks having grooves similar to those into which O-rings are placed in diesel engines. The initial back load of the specimens was measured; then they were subjected to accelerated water immersion and heat aging tests designed to simulate active and stand-by service conditions, respectively. At periodic intervals during the aging test the residual back load of the specimens was measured. Load relaxation of the specimens, defined as the ratio of the residual back load to the original back load, was calculated and plotted *versus* aging period.

The data obtained in this investigation indicated that nitrile and silicone rubber O-rings had better load retention properties than neoprene O-rings. Also, that active service was more deleterious to silicone rubber O-rings than in the case of neoprene and nitrile rubber O-rings; whereas inactive service had the opposite effect.

Although the primary purpose of this investigation was to determine the effect of simulated service conditions on diesel engine cylinder liner O-ring seals, the apparatus and test procedures described appear to be suitable for

[3] American Society for Testing Materials, Philadelphia, Pa.

evaluating gasket materials subjected to static service conditions and for research work in developing improved gasket materials.

"High-Temperature Fluid Immersion Testing of Elastomers," K. Murray, WADC.

The status of laboratory evaluation procedures for high-temperature, fluid resistant elastomers is discussed. In many instances attempts are being made to simulate environments anticipated in new high-speed vehicles. In general, however, reproducibility of test results is considered as important as the actual simulation of the environment. The validity of any evaluation procedure is its ability to yield reproducible results repeatedly within experimental error.

As aging temperatures increased beyond those described in the ASTM and other standards for rubber products, various evaluation procedures were employed to age rubber in fluids without much regard to test standardization. A number of variables accompanied the earlier standard procedures, but were tolerated because of their relative unimportance at temperatures then employed.

Increasingly high temperatures accentuated these variables and introduced new ones, and test results obtained became increasingly diverse and intolerable. Obviously this situation had to be corrected if agreement among various laboratories was to be obtained and, more importantly, in order to prepare useful procurement specifications.

The more obvious of these variables were eliminated or minimized by limiting the test rubber and oil to single batches, controlling oil-rubber ratio and conditioning temperature, and keeping variations of the test temperatures and air supply to a minimum. Data obtained during an extensive study of all these variables may be found in WADC Technical Report 58-18, "Investigation of Oil Aging Procedures for Elastomeric Materials."

An evaluation of the test results produced by this procedure, using both MIL-L-7808 engine oils and MIL-O-5606 hydraulic oils, indicated that 87-100% of the test results were within the range of experimental error, as compared with the 43% previously obtained.

As temperature requirements for elastomeric compounds continue to rise in the future, changes in evaluation procedures for elastomers in fluids will be necessary. Already, aging of an elastomer is being conducted in fluids at temperatures exceeding the spontaneous ignition temperature of the fluid, but in a closed airtight container. In all probability, future fluid immersion testing of elastomers intended for application in advanced vehicles will be conducted in sealed containers. The extreme high temperatures anticipated, together with the necessity of protecting the fluids themselves from oxidation, may result in the employment of completely closed systems in these vehicles. Laboratory evaluation in sealed containers may be more realistic than it is at the present time if conducted in this manner.

Navy Elastomer Program

The abstracts given below are those of the papers presented before the session on the Navy's Elastomer Program.

"Trends in Rubber Research," A. V. Tobolsky, Princeton University, Princeton, N. J.

Requirements for synthetic rubbers appear to fall in the following major categories: (1) An all-purpose rubber with a balanced combination of adequate physical properties, ample availability, and low cost, which at present is filled by styrene-butadiene rubber, SBR, and which in the future may have as competitors *cis*-polybutadiene, improved butyl rubber, and ethylene-propylene copolymers. (2) A premium rubber, which would provide maximum safety and life for passenger and truck tires and which might develop from the somewhat costly polyurethane polymers. A lower cost, premium-quality rubber might also develop from olefin polymers such as properly selected blends of ethylene-propylene copolymers of special structure. (3) Swell-resistant rubbers, generally of high cohesive energy density, but whose chain flexibility provides a sufficiently low glass transition temperature, T_g. The nitrile, neoprene, polysulfide, and butadiene-adduct polymers are included here. (4) Low-temperature rubbers with low T_g; polybutadiene for all-around use, and silicone rubber for special use. (5) High-temperature rubbers such as Du Pont's Viton, Minnesota Mining's Kel-F,[4] and silicone rubbers. For prolonged use at moderately high temperatures, saturated rubbers such as butadiene-adduct, polyester, and polyethyacrylate rubbers might be used. Satisfactory service at even higher temperatures than at present might be obtained by sacrificing rubberiness at room temperature.

Rubbers may be divided into the following classes: (a) those which are wholly amorphous under all conditions, even when stretched; (b) those which are amorphous under most conditions in the unstretched state, but which crystallize upon stretching; (c) those which are very slightly crystalline in the temperature interval of their use even in the unstretched condition. Rubbers in class (a) include SBR, nitrile or NBR, emulsion polybutadiene or BR, butyl or IIR, etc. In class (b) are natural rubber or NR, synthetic IR, *cis*-BR, neoprene or CR, and polyurethanes. In class (c) are plasticized polyvinyl chloride, partially N-methyl substituted polyamides, lightly chlorosulfonated polyethylene, etc.

Improved tensile and tear strength, elongation and abrasion resistance might be obtained by an extensive cultivation and expansion of classes (b) and (c). In class (a) research pointed toward improved aging, and high temperature properties may be expected, and much research should be done on improving the filler-rubber bond in all of these polymers since the physical properties depend so markedly on this bonding.

All amorphous polymers obey in a qualitative way a reduced equation of state for viscoelastic properties and probably even for tensile strength, elongation, tear strength, and other similar properties. In other words, copolymers of styrene and butadiene would show similar mechanical properties to those of copolymers of octyl acrylate and methyl methacrylate at copolymer compositions that gave the same T_g. The principle of corresponding states for mechanical behavior is useful for setting boundaries on what might possibly be expected for new amorphous polymers.

It is widely recognized that polymers with high cohesive energy density have high T_g values. It is less widely recognized that chain flexibility is also an important factor—the higher the flexibility, the lower the T_g. In order to have good low-temperature properties in the field of fluorine containing elastomers it is necessary to have flexibility in the chain backbone, such as would be conferred by $CH_2{=}CF_2$, $CH_2{=}CH(CF_3)$, $CH_2{=}CF(CF_3)$, and similar monomers.

Work with NR, SBR, IIR, polyester rubber, and adduct rubber employing the stress relaxation technique shows that NR and SBR oxidized most rapidly and gave similar rates of chain scission. The similarity in behavior of these two rubbers would be expected in terms of random chain scission involving the double bonds or the alpha methylene position in the main chain, which are abundant in both SBR and NR. Chain scission is also involved in IIR as well as SBR and NR. Data on peroxide-cured adduct rubber and polyester rubber suggested relaxation times of 1,000 hours and 300 hours, respectively, compared to 2.5 hours for radiation cured NR and 1.9 hours for radiation cured SBR. The tremendous effect of backbone structure is strikingly apparent. Sulfur cured samples of polyester and adduct rubbers both had relaxation times of 50 hours. Apparently when dealing with polymers with highly resistant backbone structures, the sulfur cross-links may become the weak points toward oxidation.

"Anionic Polymerization Mechanisms." C. G. Overberger, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

[4] Polytrifluorochloroethylene, Minnesota Mining & Mfg. Co., Jersey City chemical division, Jersey City, N. J.

The molecular weight of polymethacrylonitrile obtained in the system lithium-ammonia-methacrylonitrile at —75° F. increased with decreasing concentrations of lithium and increasing concentrations of methacrylonitrile and in addition was found to be proportional to (methacrylonitrile)/(lithium). On the basis of this and additional evidence, a one electron transfer from lithium to methacrylonitrile to give an anion radical is postulated. In addition, the structure of the colored polymer obtained is discussed on the basis of the infrared spectra.

The molecular weight of polymethacrylonitrile obtained in the system potassium-ammonia-methacrylonitrile at —75° F. does not depend on the concentration of either potassium or methacrylonitrile. An entirely different mechanism is operative here. Evidence is presented to show that reduction of methacrylonitrile occurs rapidly with subsequent formation of amide ion. A chain mechanism is proposed.

"Hydrolytic Degradation of Urethane Polymers," Maurice Morton, Institute of Rubber Research, University of Akron, Akron, O.

A study has been carried out on the kinetics of the acid- and base-catalyzed degradation of urethane polymers in solution. Both the poly (ether urethane) and poly (ester urethane) type of materials were examined and compared with the original unextended polyether and polyester.

The polyether appeared to be very stable toward either acid or base, while the poly (ether urethane) was relatively stable toward acid, but readily attacked by base. Hence the urethane link appears to be the point of attack. The kinetics were found to be first-order with respect to both the polymers and the base concentration, i.e., overall second-order. In addition to this random degradation process, however, there was evidence for the existence of a special "weak linkage," which led to a very rapid, but limited, initial degradation, either in acid or alkaline media.

The poly (ester urethane), on the other hand, underwent substantial degradation in acid media, at a similar rate as the unextended simple polyester, indicating a random attack on the ester linkage. The kinetics showed a first-order dependence on both the polymer and acid concentration. The presence of water, however, led to some anomalous results, indicating a solvent effect.

"Research on the Ultimate Properties of Elastomers," A. M. Bueche, General Electric Co., Schenectady, N. Y.

Recent experiments have shown that the crack propagation rate during the failure of elastomers depends on the modulus and density in the same way as was found for metals, glasses, and plastics. This led to investigate the applicability of the Griffith criterion for tensile strength.[5]

J. C. Montermoso

The Griffith theory relates the tensile strength to the modulus, the size of the longest sharp imperfection, and to the energy necessary to form one square centimeter of the fracture surface. Experiments on silicone elastomers confirmed the predicted inverse square root dependence of tensile strength on imperfection size. The surface energy calculated using measured values of the moduli, however, was much larger than might be expected from bond energy considerations.

Similar unrealistic surface energies have been found in experiments with metals. They have been explained by Orowan as being due to an additional energy loss mechanism not taken into account by the Griffith theory. Investigation of the deformation losses in silicone elastomers, and electron microscopic examinations of fracture surfaces, failed to account for the observed discrepancy.

Unfilled silicone gum rubber samples, in which deformation losses are small, were prepared with different amounts of cross-linking using high energy electron irradiation. It was found that as the cross-linking increased, the surface energies tended toward more realistic values. Since the elongation at break decreases with increasing cross-linking, the results may be explained in terms of changes in the radius of curvature at the tip of the imperfection.

"Elastic Properties of Pure-Gum Rubber Vulcanizates," Lawrence A. Wood, National Bureau of Standards, Washington, D. C.

Shear creep data for natural rubber at temperatures from —60 to +50°C. at times from five seconds to five minutes can be represented by a single sigmoid curve giving the product of shear compliance J and temperature T as a function of the logarithm of the equivalent time at —60° C. The temperature function used for calculating equivalent time is that of Williams, Landel, and Ferry. Two empirical equations, covering different ranges, have been found which represent the sigmoid curve over all times and temperatures at which observations can be made without appreciable degradation and flow. For the highest five decades of equivalent time the product of compliance and temperature is approximately linear with the logarithm of equivalent time, showing no indication of an approach to a constant value. The creep behavior observed with tensile stresses is similar to that with shearing stresses; the time-temperature equivalence function often depends on the vulcanization conditions. The creep, in any case, is seldom less than 2% per decade of time.

The isothermal stress-strain curves in extension and compression after a given period of creep for most of the simplest vulcanizates of natural rubber and by the three most common synthetic rubbers are similar in shape and can be represented by the empirical equation

$$F = M\ (L^{-1}-L^{-2})\ \exp A(L-L^{-1})$$

where F is the stress, L the ratio of stretched to unstretched length, and M and A are constants. The constant A has a value of about 0.38. The constant M is Young's modulus, (3/J), and depends on the nature of the rubber, the extent of vulcanization, and the time of creep. For pure-gum natural rubber vulcanizates at 25° C. the value of M at one minute is generally between 10 and 20 kg/cm². For normal conditions of vulcanization the value is most often between 12 and 15 kg/cm². Values of M and the creep are the most important parameters describing the elastic behavior of a vulcanizate over its normal range of use.

"Dynamic Properties of Elastomers at High Temperatures," C. B. Griffis, V. S. Javier, and Angus Wilson, Quartermaster Research & Development Center, Natick.

Many military items require elastomeric components capable of performance in air and in liquids at high temperatures. Materials for these components are often evaluated for service by exposing them to high temperatures, then returning them to room temperature and measuring change in physical properties. These procedures, while giving a rather rough comparative rating of materials, do not give full information as to their properties at the high temperatures.

A new method is described for measuring the properties of elastomers both in air and liquids at high temperatures. It has been observed that in most applications rubber items are

[5] A. A. Griffith, *Trans. Roy. Soc. (London)*, Series A, 221, 163 (1921).

generally not elongated beyond 50%. Accordingly, the high temperature measurements were made at low elongations. Data are given for various elastomeric materials.

"Polymer Melt Compressibility," Bryce Maxwell, Princeton University.

Polymer melts have been found to be highly compressible. Since the application of hydrostatic pressure is used in the fabrication of molded and extruded articles, it is important to know the effect of pressure on the properties of the finished items and on the flow characteristics of the polymer melt during the fabrication operation.

It has been shown that the compressibility characteristics of amorphous linear polymers and polymers capable of exhibiting ordered crystalline structures differ markedly. The results of studies of the bulk compressibility of linear amorphous polystyrene and linear polyethylene will be presented as examples of these two general categories. The effects of temperature and rate of compression indicate that the response of the amorphous polymer is composed of a combination of two mechanisms in the rubbery region.

In the polycrystalline material (polyethylene) an additional effect, that of pressure induced crystallization, is also observed. Owing to the large difference between the amorphous and crystalline densities in polyethylene, the application of hydrostatic pressure results in a strong driving force toward the ordered, high density state. Similar studies on isotactic polypropylene and isotactic polystyrene indicate that pressure induced crystallization is not so easily achieved. The importance of these effects to the fabrication operations will be discussed.

Since polymer melts are compressible, the flow characteristics of their melts are affected by hydrostatic pressure. An apparatus for the study of apparent viscosity under the application of controlled hydrostatic pressure will be described. The results of tests with this apparatus indicate a 135-fold increase in apparent viscosity in polystyrene under the application of pressures no higher than those encountered in injection molding.

"Dynamic Mechanical Properties of Polyolefins," Bryce Maxwell.

The utility of the dynamic mechanical test (mechanical spectrometry) in rapidly evaluating the mechanical properties of polymers will be discussed. The frequency and temperature response of some polyolefins over the following ranges will be presented: linear polyethylene, 0.01 to 100 c.p.s., —10° to 100° C.; isotactic polypropylene, 0.01 to 100 c.p.s., —10 to 120° C.; blend of polyethylene and polypropylene, 0.01 to 100 c.p.s., —10 to 120° C. The response of linear polyethylene in this range indicates that its mechanical properties are dependent on the visco-elastic behavior of the amorphous regions between crystallites. The relaxation times of the forces giving rise to the response of these regions are markedly dependent on both time of straining and temperature. On the other hand, the mechanical spectra of isotactic polypropylene indicate very little time of straining dependency, but very strong temperature dependency. The blend of these two materials produces spectra that exhibit a combination of the responses of the two materials.

Another mechanical property which can be studied by means of the dynamic test is the limit of linear visco-elastic response. The importance of this characteristic of materials in engineering design will be discussed. A technique for measuring the strain limit of linear visco-elastic response will be presented. Tests on linear polyethylene and isotactic polypropylene indicate that the limit of linear visco-elastic response is temperature and frequency dependent. The utility of this measurement in interpreting the mechanical behavior of polymers as a function of structure will be discussed.

"Thermal Degradation of Organic Polymers," S. L. Madorsky, National Bureau of Standards.

The temperature at which an organic polymer disintegrates, the nature and relative amounts of products, as well as the mechanism and rate of such a degradation, depend primarily on the molecular structure of the polymer. Thus, with regard to thermal stability, some polymers, such as polymethyl methacrylate or poly-α-methylstyrene, degrade at about 150-250° C.; while other polymers such as polymethylene or polytetrafluoroethylene, degrade at about 400-500° C. Also, with regard to products of thermal degradation, some polymers, such as poly-α-methylstyrene or polytetrafluoroethylene, yield only the monomer; while other polymers, such as polyethylene or polymethylene, yield a spectrum of molecular fragments from CH_4 to others having as high a molecular weight as will permit them to evaporate at the decomposition temperature. Yet there is another type of polymers in which, under the influence of heat, side groups break off first, leaving behind chains studded with double bonds and having cross-linkages between the chains. Such polymers are, for example, polyvinyl chloride or polyvinylidene fluoride.

The most stable organic polymers, that is, those which retain a more or less carbonized residue, are those which form cross-linkages in the early stages of degradation, or, still better, which have an initial highly cross-linked structure.

Studies on thermal stability and on the nature and relative amounts of products of thermal degradation have been made by our group at the National Bureau of Standards, mostly under high evacuation in specially designed molecular stills. In some cases the same apparatus was used in experiments in a neutral atmosphere at normal pressure. Until recently the temperatures employed were below 800° C. Preparations are now in progress to extend the temperature range up to about 1500° C.

Rates of thermal degradation were measured by the loss-of-weight method, using either a specially designed very sensitive tungsten spring-balance apparatus provided with automatic control to maintain constant temperature, or an apparatus built around a very sensitive electronic balance. This last apparatus, in addition to having automatic temperature control, is provided also with automatic recording of temperature and rate of loss of weight of the sample undergoing degradation.

"Crystalline and Amorphous Orientation in Polyethylene," Richard S. Stein, University of Massachusetts, Amherst, Mass.

The orientation of the crystals of polyethylene may be described by specifying orientation functions for the three crystal axes. The state of orientation may be described by plotting two of these three functions on a triangular "orientation diagram." The functions may be determined from a study of the azimuthal variation of the intensity of diffracted X-rays from suitable crystal planes. This has been done for both low- and high-density polyethylene. It is found that both the a and b crystal axes tend to orient perpendicular to the stretching direction during drawing, but the a axis orients more readily than the b. The orientation of the b axis occurs more readily with low-density polyethylene than with high.

The contribution of the crystals to infrared dichroism and birefringence may be calculated from these orientation functions. Good agreement between the calculated and measured values of the dichroism of the infrared crystalline band at 730 cm.$^{-1}$ is obtained.

The infrared band at 720 cm.$^{-1}$ results from both crystalline and amorphous contribution. By subtracting the calculated crystalline contribution from the total, the dichroism of the amorphous regions may be calculated. This characterizes the amorphous orientation which appears to be rather high.

The birefringence results from orientation of both crystalline and amorphous material. The crystalline contribution may be calculated from crystal refractive indexes and from the orientation functions, and the amorphous contribution may be calculated by difference. By using values of bond

polarizabilities, the amorphous orientation may again be estimated. The results are high, but agree well with those obtained from infrared dichroism.

The amount of crystalline and amorphous orientation is found to depend upon the polymer density and the temperature of stretching. It is thought that these changes are closely related to changes in mechanical properties.

"The Influence of Accelerator Residues on Age Resistance of Elastomeric Vulcanizates," Z. T. Ossefort, Rock Island Arsenal, Rock Island, Ill.

Recent aging studies on both SBR and natural rubber vulcanizates prepared using the following curing systems have indicated that *only* those vulcanizates based on the accelerators (in the absence of sulfur) have excellent age resistance whether inhibited or uninhibited: (1) sulfur-accelerator, (2) accelerators only, (3) peroxide, (4) radiation.

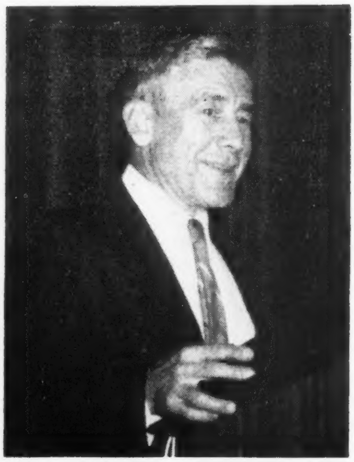
It was the objective of the present study to attempt to ascertain whether variations in aging among vulcanizates prepared using cures cited above were due primarily to variations in the stability of the resulting network structure or to variations in the efficiency by which the inhibitor protects the vulcanizate.

Vulcanizates based on the curing systems listed were subjected to accelerated aging both before and after (1) acetone extraction of specimens, (2) impregnation of the vulcanizate with selected ingredients. Pertinent physical properties were determined for the purpose of following the extent of aging.

Results indicated that the age resistance under these conditions was a primary function of the inhibitor present whether ths inhibitor was added to the rubber or formed *in situ* from accelerator residues resulting during the curing process. It was found that curing with a thiuram-thiazole combination (in the absence of elemental sulfur and inhibitor) resulted in the formation of an extremely active inhibitor from the curative residues. Removal of this "inhibitor" resulted in a very poor aging compound. When it was replaced in the vulcanizate, the original outstanding age resistance of this vulcanizate was very nearly completely restored.

"Time-Temperature Behavior of Rubber from Measurements of Indentation Hardness," Frank L. Roth, National Bureau of Standards.

The indentation hardness of several rubber compounds was measured at intervals from 5 to 600 seconds at temperatures ranging from -60 to $+25°$ C, by means of the International Rubber Hardness tester described in ASTM Designation D 1415-56T. For this purpose, the tester was equipped with a special low-temperature chamber which housed only the specimen and



J. H. Faull, Jr.

the indentor with foot. Low temperatures were obtained through the use of liquid nitrogen.

The relations in ASTM D 1415 were used to calculate values of Young's modulus M from the hardness measurements. In accord with the findings of others, plots of the product of the corresponding shear compliance, $J = 3/M$, and the absolute temperature T against log (time) were made at each temperature. By arbitrary shifting along the log (time) axis, the curves for the different temperatures were made to coincide over their common ranges, forming a single continuous curve. These plots and plots of the log (time equivalence of temperature) against T characterized the time-temperature behavior of rubber vulcanizates from the glass transition temperature to $+25°$ C. This temperature range corresponded to as much as 14 units in the log (time) scale.

The rubber vulcanizates investigated included gum compounds of natural, butyl, neoprene, and nitrile rubbers, and carbon black compounds of natural, styrene-butadiene, and nitrile rubbers. Some difficulty was encountered in making hardness measurements of neoprene compounds at intermediate temperatures because of crystallization.

The time-temperature behavior was found to vary from one compound to another, even for those of the same rubber. The time of cure was also found to influence the time-temperature behavior of the vulcanizates. No unique relation was apparent for characterizing all the vulcanizates.

"Studies of Crystallization and State of Cure of Neoprene W Using Dielectric Measurements," M. Hanok and I. N. Cooperman, New York Naval Shipyard, Brooklyn, N. Y., and G. Adler, Brookhaven National Laboratory, Brookhaven, N. Y.

A study of the dielectric properties of a Neoprene W compound was conducted to determine whether measurements of dielectric constant and dielectric loss would show the state of cure. Preliminary work indicated that crystallization of this linear polar polymer affected the dielectric properties. It was then decided to include crystallization studies and to determine whether the measurements also could be used to follow crystallization change as a time-dependent phenomenon. The work was based on the concepts that increased hindrance to the rotation of the polar polymeric chains in an alternating electric field, either in the form of additional network cross-links or increased orientation of polymer chain segments, would decrease the dielectric constant at a given frequency, and that shift would occur in the critical frequencies for vulcanizates in different states of cure.

The elastomer compound used in the experimental work was a zinc oxide, magnesium oxide Neoprene W gum stock, cured at 290° F. at periods ranging from 30 to 200 minutes. Measurements of dielectric constant and dielectric loss were made at 1,000 cycles per second on each of the vulcanizates at intervals of one hour, three weeks, 10 weeks, 19 weeks, and 36 weeks after cure. Measurements were also made of the 30-minute and 180-minute cured stocks at frequencies ranging from 50 cycles to 7 megacycles per second. All measurements were made at a temperature of 73° F., using a capacitance bridge having a Schering-type circuit for frequencies below 75 kilocycles, and a Q-meter for frequencies greater than 75 kilocycles. A micrometer electrode type of sample holder was used in all of the measurements.

The results at 1,000 cycles showed differences in the dielectric constants of vulcanizates cured at various intervals and showed changes in dielectric constants with time after cure. A critical frequency of 12 megacycles was indicated for the Neoprene W compounds cured at both 30 minutes and 180 minutes.

"Vinylic Filler Reinforcement of Elastomers," by Oliver W. Burke, Jr., Burke Research Co., Detroit, Mich.

The development by our organization of vinylic fillers for the reinforcement of elastomers has been supported for several years by the government research including contracts with the Reconstruction Finance Corp., the National Science Foundation, and now under Contract No. DA-20-018-ORD-17071 with the Department of the Army, Detroit Arsenal.

Large-size military tires built with carbon black reinforced GR-S (SBR) when running at high speeds and under the ever-increasing military load requirements develop excessive heat, and the tire life is thus diminished.

The object of the research has been to provide low heat build-up reinforcing fillers to replace all or part of the carbon black in SBR compounding for building larger-size military tires.

During the course of the research work it has been found that synthetic elastomers can be reinforced with organic fillers especially cross-linked, rigid, polymer particles in the colloidal-size range which are prepared by emulsified polymerization of monomers capable of cross-linking, that is having a plurality of vinyl or allyl groups with or without other monomeric materials. Organic fillers of this type have been termed vinylic fillers.

To obtain vinylic fillers with low hysteresis when compounded with SBR it has been found that polymeric emulsifiers must be employed in place of conventional non-polymeric emulsifiers in the emulsion polymerization of the filler. Vinylic fillers prepared with carboxyl groups available on the particle surface yield compounds of high tensile strengths when compounded with SBR. The most suitable size for vinylic fillers is in the range of 200-1000 Angstroms; thus these particles are somewhat smaller than conventional reinforcing carbon black.

Butadiene copolymer elastomers with maximum reinforcement are loaded with vinylic fillers in amounts similar to carbon black loadings (20-50 parts by weight based on 100 parts SBR). Combinations of vinylic fillers and SBR type synthetic rubber have now been developed which, according to laboratory tests, have physical properties equal to those of carbon black reinforced SBR and further have considerably lower heat build-up.

Air Force Elastomer Program

The abstracts of the papers given before the final session on the Air Force Elastomer Program follow.

"New Polymer Prospects for High-Temperature Service,"[6] Leo A. Wall, W. J. Pummer, and S. Straus, National Bureau of Standards.

Investigations have been made on decomposition of new fluorocarbon polymers in the absence of air at temperatures near 500° C. Of the series of polymers that were studied, the most stable were Teflon 100X, which is a copolymer of hexafluoropropylene and tetrafluoroethylene, and some polymers that were prepared by Prof. H. C. Brown, of the University of Florida, from perfluoroglutaro or adipo diamidine with perfluorobutyroamidine. The latter materials are rubbery and have glass transitions at —10 and —18° C.

The activation energy for thermal decomposition of the diamidine polymers is around 40 kcal per mole; while for Teflon 100X it is about 55 kcal. These energies are quite low compared to the 80 kcal for Teflon. However, though their activation energies are low, their rates of decomposition are appreciably lower at 500° C. than the rates for Teflon. As a consequence of the widely differing activation energies, the amidine polymers and Teflon 100X,

A. M. Lovelace

though less thermally stable below 500° C., are actually more stable than Teflon above 500° C. Of course, above 500° C. only short-time usage, a few hours at most, could be contemplated with any of these materials.

Aromatic fluorocarbon syntheses are being investigated for the purpose of obtaining polymers stable at 500° C. and above. Earlier work with perfluoropolyphenyl indicates a good thermal stability. For better physical properties synthesis of other aromatic fluorocarbon polymers are being developed.

Preparations of perfluorophenol and its salts of sodium, silver and ammonium have led to the production of low molecular weight gummy substances believed to have the structure —$[C_6F_4O]$—. Higher molecular weight polymers of this tetrafluorophenylene ether may possibly be prepared by the decomposition of tetrafluorobenzene-1,4-diazo oxide. Work toward the synthesis of this substance is being given high priority.

Aromatic di- and mono-amidines offer other possibilities. The synthesis of pentafluorophenyl cyanide from pentafluoroiodo-benzene has been carried out as a first step in this direction.

"High-Temperature Fluorinated Elastomers," Henry C. Brown, University of Florida, Gainesville, Fla.

A new system of thermally stable polymeric materials containing carbon, fluorine, and nitrogen has been developed based on a condensation reaction of perfluoroalkyl amidines which forms the *sym.* triazine structure with the elimination of ammonia.

Initial work in this area showed that a perfluoroalkyl amidine would form the cyclic trimer of the parent nitrile by continued heating:

Further work with perfluoroglutarodiamidine and perfluoroadipodiamidine, formed by addition of ammonia to the corresponding dinitrile, showed that a similar reaction occurs on heating and that the final products from these difunctional compounds are hard, insoluble resins that are stable for long periods in air at 350° C. (662° F.) and are also resistant to strong oxidizing mineral acids.

Copolymerization of perfluoroglutarodiamidine or perfluoroadipodiamidine with perfluorobutyramidine produces, as one modification, elastomeric gums that have rubber-like properties. These copolymers show no degradation beyond an initial weight loss when heated in air for 72 hours at 350° C. A sample refluxed for 24 hours with red fuming nitric acid showed no degradation and no change in gross physical properties other than a lightening of color.

Present indications are that these copolymers incorporate a triazine structure, but with considerably less cross-linking than that formed in the homopolymers produced from the perfluoroalkyldiamidines alone.

Studies of synthesis and monomer modification and possible curing procedures are now being made.

"High-Temperature Elastomer Research," L. W. Butz, Office of Naval Research, Washington, D. C.

In ONR planning we are chiefly concerned with two subjects, selection of chemical systems for synthesis and best development of materials after new stable systems are discovered. Emphasis is to be on the synthesis of wholly inorganic polymers, but there will be some research on particular points concerning fluorocarbons, siloxanes, and benzenoid and other conjugated systems containing carbon to carbon bonds. Research on the properties of novel polymers is to be sponsored as soon as materials are available and as intensively as facilities and funds allow, so that the polymers may be developed as quickly as possible into useful materials or rejected as showing relatively little promise. Our experience in managing such a new polymer properties research program will be described. Two or three large groups of research workers in polymer physics appear to be required.

"The Polymerization of 'Inorganic Rubber,' Dichlorophosphinic Nitride," C. P. Haber, U. S. Naval Ordnance Laboratory, Corona, Calif.

There is no information on the literature which gives insight into the mechanism of the reaction by which the cyclic trimer and tetramer of dichlorophosphinic nitride are transformed into an elastomer. In an effort to elucidate this unique reaction, rate studies both in bulk and in solution have been made.

[6]Based on work supported by the Bureau of Aeronautics and Office of Naval Research, U. S. Department of the Navy, Washington, D. C.

The uncatalyzed reaction is so slow that despite rigorous control of reaction conditions, the experimental results were so scattered that no interpretation was possible. It has been found, however, that a wide variety of oxygen-containing organic compounds as well as certain metals have a marked catalytic effect on the rate of polymerization. Experimental evidence has shown that the rate is proportional to the first power of the catalyst concentration in the case of benzoic acid and diethyl ether catalyses. Preliminary results indicate that the rate is proportional to the 3/2 power of the trimer concentration. By utilizing some reasonable assumptions a gross mechanism can be derived which fits the rate studies. The evidence and the derivation of the mechanism will be presented.

"Organo-Tin Elastomers," L. P. Marinelli T. M. Andrews, and J. C. Montermoso, Quartermaster Research & Development Center.

As part of a program aimed at the development of organo-metallic elastomers having thermally stable and chemically resistant properties, investigations in our laboratory have been focused on organo-tin compounds; specifically, on the reactions of tributyltin methacrylate with fluoro-, chloro-, or phosphorus-containing unsaturated compounds. Methacrylic acid reacts readily in 1:1 ratio based on the mono-functionality of tin in tributyltin oxide to form a crystalline monomer that may be subsequently homopolymerized to an elastomeric product or copolymerized with other unsaturated compounds to rubbery materials. The reactions studied fall into the following four groups: (1) monomer synthesis—preparation of tributyltin methacrylate; (2) homopolymerization of tributyltin methacrylate monomer; (3) copolymerization of tributyltin methacrylate monomer with bis (β-chloroethyl) vinyl phosphonate; (4) copolymerization of tributyltin methacrylate monomer with trifluoroethyl vinyl ether.

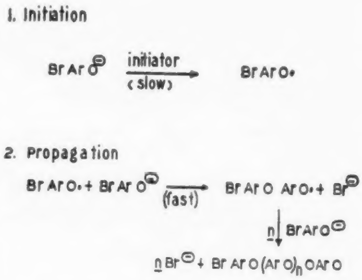
Of the two systems, solution and emulsion, available for polymerization to yield elastomeric products, only the emulsion system utilizing either the lauryl mercaptan-potassium persulfate or the potassium persulfate-sodium bisulfite (Redox) systems produced tough, rubbery products.

"Polyphenylene Oxide Polymers," Gerald Staffin and Charles C. Price, University of Pennsylvania, Philadelphia, Pa.

Earlier work on polymers of 2,4,6-trihalophenols[7] has been extended to the preparation of polymers from 2,6-dimethyl-4-bromo-phenol.

We have found the sodium salt of this phenol to be extremely stable, except in the presence of reagents capable of oxidizing the phenolate ion to a phenoxide radical. Shaking aqueous solutions of the phenolate with 2-10 mole % of such reagents as iodine, benzoyl peroxide, ferricyanide ion or lead tetraacetate leads to rapid conversion to polymer and liberation of bromide ion. The polymer thus formed in a few minutes at room temperature has $[\eta]$ ca. 0.2, is soluble in benzene and other organic solvents, has a softening point of ca. 200° C., has a bromine content equivalent to a degree of polymerization of about 20 and is formed in a yield corresponding to about 20 moles of phenolate converted per mole of initiator consumed.

We believe the evidence supports a mechanism involving radical displacement of a bromide ion.



We have no evidence bearing on the nature of the termination reaction.

"Quartermaster Corps Sponsored Fluoroelastomer Research at 3M," G. H. Crawford, Minnesota Mining & Mfg. Co., St. Paul, Minn., and Juan C. Montermoso, QRDC.

In order to develop solvent resistant rubbers for critical service at —70 to +160° F., the Quartermaster Research & Development Cener and 3M Central Research Division are engaged in a joint research effort. Polymerizations research and polymer evaluation are conducted at 3M and QMR & D Center, respectively. Supporting monomer synthesis research is carried out by Paul Tarrant (University of Florida) and J. D. Park (University of Colorado).

The research program embraces two broadly defined categories: "Immediate Range," in which new fluoro monomer systems are interpolymerized by conventional reactions to polymer types for which structure-property relations have been developed; and "Long Range," in which reactions give rise to macro molecules having new or unusual combinations of atoms in the backbone.

Immediate-range work is directed at a few structures of particular interest. Emphasis has shifted to the long-range category where latitude for future breakthrough exists. Of immediate-range systems studied,

$CH_2{=}CHCH{=}CH_2$ / $CF_2{=}CFCH{=}CH_2$ (1)
$CH_2{=}CF_2$ / $CF_3CF_2CF{=}CH_2$ (2),
and $CH_2{=}CH_2$ / $CF_3CF_2CF{=}CH_2$ (3),

appear most interesting. The previously studied system (1) was found to combine a —40° C. Gehman T_{10} with reasonable resistance to solvent swell when prepared in 15/85 mole ratio. Developmental studies are in progress. Systems (2) and (3) show promising combinations of low- and high-temperature serviceability.

In the long-range category, copolymers of CF_3CHO, C_3F_7CHO, and $CF_3N{=}O$ with ethylenically unsaturated fluoromonomers have been prepared. Fluorocarbon aldehydes can be polymerized through C=O by anionic and cationic catalysts. $CF_3N{=}O$ copolymerizes spontaneously with $CF_2{=}CF_2$, $CF_2{=}CFCl$, and $CFCl{=}CFOCH_3$. Polymerization presumably occurs across the N=O linkage at low temperatures. $CFCl{=}CFO\text{-}CH_3$ yields a thermoplastic. Elastomeric gums are obtained with $CF_2{=}CF_2$ and $CF_2{=}CFCl$.

"Compounding of Fluoroelastomers for Aeronautical Applications," W. R. Griffin and J. M. Kelbe, WADC.

The fluoroelastomers, in particular the hexafluoropropylene/vinylidene fluoride copolymer known as Viton and commercially available from Du Pont, with proper compounding techniques will provide rubber items which have excellent fluid and heat resistance for many aeronautical applications.

The WADC Materials Laboratory has developed a relatively simple compound which gives the best overall balance of properties both before and after aging and which is best cured with hexamethylene diamine carbamate. This compound has been used as a basis for MIL-R-25897 which, among other things, requires excellent retention of physical properties after air aging for 16 hours at 600° F. and 70 hours' immersion testing at 400° F. in high-temperature hydraulic fluid.

One of the most noteworthy advancements in fluoroelastomer compounding has been the development by the WADC Materials Laboratory of a room-temperature vulcanizing system for perfluoropropylene/vinylidene fluoride copolymers. This system appears to be a major breakthrough in the development of high-temperature resistant integral fuel tank and structural sealants.

Viton elastomer has by no means completely solved even all of today's problems, much less those of tomorrow. The solution of these problems will lie in the continuing cooperative efforts of industry and the various Service agencies in the development of new polymers and appropriate compounding techniques, and, in this connection the work with Viton will serve as an excellent example and criteria for future advancements.

"New Silicone Rubbers," E. L. Warrick, Dow Corning Corp., Midland, Mich.

[7]W. H. Hunter *et al., J. Am. Chem. Soc.,* 55, 3701 (1933) and earlier papers; M. J. S. Dewar, A. N. James, *J. Chem. Soc.,* 917 (1958).

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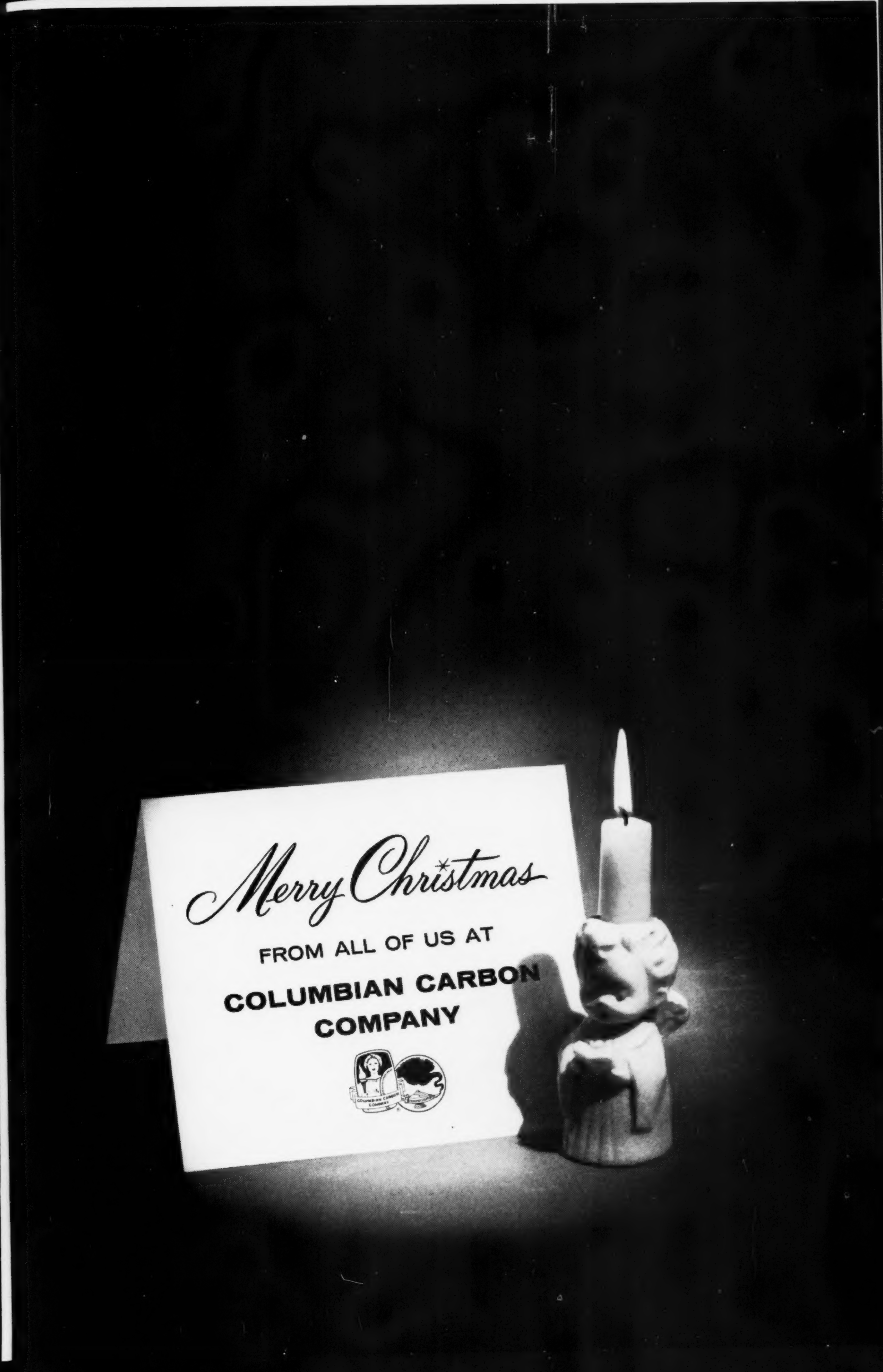

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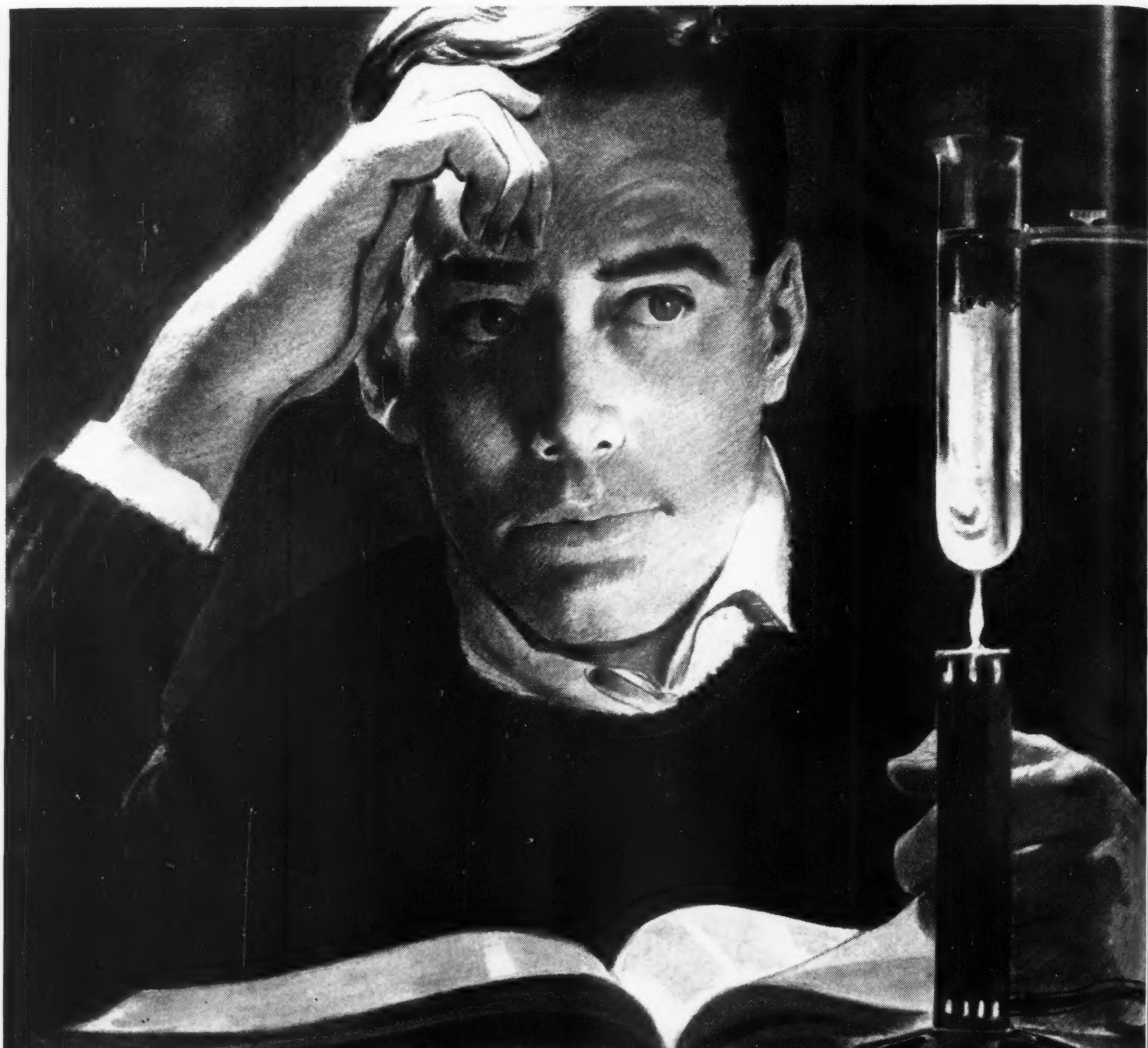


The genesis of new silicone rubbers is as vital as the imagination of our scienists. New rubbers stem from composition changes wrought by organic chemists. New properties found by physical chemists allow for new uses which in themselves generate new polymers. The need of new forms and modes of application lead polymer chemists to new techniques of curing. These forces have been producing new silicone rubbers at a significant rate for almost 14 years, and they give every promise of continuing at an accelerated rate.

The basic siloxane chain has an attribute which makes it particularly attractive to organic chemists interested in rubber. This is the inherent flexibility of the siloxane chain and its tolerance for a wide range of substituents without loss of rubbery properties. Recently chemists have been adding large amounts of phenyl substituents to improve radiation resistance, and this has been achieved without appreciable loss of rubbery characteristics.

These same rubbers are more promising for simple high-temperature uses because of greater oxidative stability. The incorporation of fluorine in the hydrocarbon substituent has served to improve fuel resistance, but the ability to form virtually any type of organic substituent presages the coming of a whole host of special fuel and solvent resistant elastomers. There are indications that many of the goals of organic chemists in modifying silicone rubbers will be achieved by grafting techniques rather than by straight forward classical organic chemistry.

Conventional silicone rubbers are more permeable to oxygen, nitrogen, and carbon dioxide than polyethylene by a factor of 200- to 700-fold. At the moment this is exciting to a few surgeons and heart specialists, but one could visualize this as a needed property in many areas. It has been shown that silicone rubbers contract and increase tension when crystallized. This is diametrically opposed to the behavior of natural rubber and needs only a fertile imagination to find use.

The need of the special advantages of a silicone rubber without the use of ordinary press and oven cures brought forth a whole series of room-temperature vulcanizing (RTV) stocks. More recently it has been found possible to achieve this without mixing in a catalyst, and an ideal tube-type calking material was produced. The availability of machines producing high energy radiation and the possibility of using byproduct radioactive isotopes has stimulated work in the area of radiation vulcanization. It is possible to cure some silicone rubbers at levels 1/25 to 1/50 of the radiation dose required by natural rubber.

The pressure of new needs, new properties, and new tools continues to produce silicone rubbers of an ever-expanding range of utility.

C. S. Marvel

"The Properies and Evaluation of Coral Rubber," R. F. Dunbrook, Firestone Tire & Rubber Co.

Coral rubber is the name given by Firestone to a synthetic *cis* 1,4-polyisoprene having essentially the structure of *Hevea* natural rubber. Coral rubber is prepared by polymerization of isoprene in solution or mass with a lithium based catalyst. The rubber prepared according to the Firestone process contains 93 to 94% *cis* 1,4-structure and 6-7% 3,4-structure compared to 97.8 and 2.2%, respectively, for *Hevea*. The X-ray pattern of Coral rubber is very similar to that of *Hevea*. The molecular weight is or can be made, however, much higher than that of *Hevea brasiliensis*.

The physical properties of Coral rubber stocks, when compounded in gum, body, or tread recipes, are nearly identical with those of natural rubber. In low hysteresis and retention of physical properties at elevated temperatures, Coral rubber is found to be equal to natural rubber.

Passenger tires, truck tires and military tires have been built and tested, and we are fully satisfied that Coral rubber can be used successfully in those applications where natural rubber is now used.

The low hysteresis properties of Coral rubber make it applicable for motor mount stocks where conditions of constant energy input prevail. Under conditions of service the Coral mounts out-performed those of natural rubber by more than two-fold.

We have just completed pilot plant studies during which several tons of Coral rubber were produced. This rubber has been used to study factory handling, processing, and compounding with conventional equipment. The Firestone process is a commercial one, and from pilot plant studies sufficient data has been accumulated to permit the design and construction of a commercial plant.

The work carried out to date on the synthesis of natural rubber and its evaluation leads us to the conclusion that synthetic *cis* 1,4 polyisoprene is the full equivalent of the natural product in all respects and that in the event of war the United States would not need to depend on natural rubber supplies.

Tires Dealers To Meet

The fifth annual Tire Dealers' Management Program will be held at the University of Akron, Akron, O., on February 2-7. Of special interest to tire dealers, the program has been scheduled for the exchange of creative ideas in tire merchandising. Included are the practical panels and discussions drawing upon the merchandising executives from the industry as well as manufacturers, associations, individual dealers, and University lecturers.

To apply the material presented at the program, problems will be presented and discussed. In addition, the program members can present their problems and have them considered. Special discussion periods, moreover, have been provided. Every opportunity will be given for participation.

Fee for the program, which covers tuition, luncheons, dinners, and banquet, is $150.00. For further information or to register, write: Dean Warren W. Leigh, The University of Akron, Akron, O.

"Catalytic Lithium"

Foote Mineral Co., Philadelphia, Pa., has developed new forms of lithium for use as catalysts and intermediates. Termed "Catalytic Lithium," these comprise: lithium metal dispersions and lithium hydride dispersions—finely dispersed solids in hydrocarbon solvent; and lithium butyl—an organometallic solution. These catalytic systems are designed for use as catalysts in polymerization and as catalysts or intermediates in organic syntheses and other organic reactions.

An outstanding characteristic of the new catalysts is their high reactivity in comparison with conventional dispersions now available, according to Foote technical personnel. The increased reactivity is explained to exclusion of oxygen from the system, small uniform particle size, and absence of dispersing aids that are undesirable.

The lithium in Foote's new metal dispersion has the following analysis: lithium, 99.88%; sodium, 0.02%; potassium, 0.07%; nitrogen, 0.012%; chlorine 0.04%; calcium, 0.0001%; iron, 0.0005%; aluminum, 0.0005%; silicon, 0.001%.

Akron Group Tire Testing Symposium

General Tire Photo

Fig. 1. Akron Rubber Group tire testing panel *(left to right, standing):* Moderator R. J. Brown, J. W. Drew, F. C. Leone; *(sitting):* F. S. Conant, W. F. Perkins, and A. H. Easton

The Akron Rubber Group held a symposium on tire testing methods at its technical session at the October 24 meeting held in the Sheraton Hotel, in Akron, O. The use of some rather unique tests and equipment along with some more conventional methods was covered.

As usual, a large turnout attended the meeting. The group heard former Olympic track star Jesse Owens speak, following the evening banquet. Approximately 600 members and guests heard the famous runner describe some of his athletic triumphs and experiences, but Mr. Owens concentrated much of his talk on the work and pleasure he derives from his current work with young people. He spoke of the benefits of athletics for the youth of the country, but warned that care must be taken to prepare them for the letdown sure to come if they are idolized during the period of their sports activities.

The technical session held during the afternoon was moderated by R. J. Brown, Goodyear Tire & Rubber Co., and went into several facets of tire testing. The number of panelists and length of presentations prevented any question-and-answer period being held. The panel members (Figure 1) were W. F. Perkins, B. F. Goodrich Tire Co., Akron; F. S. Conant, The Firestone Tire & Rubber Co., Akron; A. H. Easton, University of Wisconsin, Madison, Wis.; J. W. Drew, The Goodyear Tire & Rubber Co., Akron; and F. C. Leone, Case Institute of Technology, Cleveland, O.

Indoor Testing

W. F. Perkins spoke on "Laboratory and Indoor Tire Testing." The whole field of testing is tied to the problem of tire design, and Mr. Perkins pointed out that since most of the desired requirements are not compatible, the design must be a compromise of several factors. With durability as a common desirable property it must be balanced against the opposing factors of ride qualities, steering response, traction, and noise. (See Figure 2.)

These factors must be reevaluated for each different type of tire such as aircraft, truck, passenger car, bus, or off-the-road and are further complicated by the variety of each type of tire offered for any particular use. For example, the so-called low priced three autos have available some 16 or 18 variations of tires with which they can be equipped.

This situation makes tire evaluation by a single or simple set of tests an impossible task, and it was emphasized that tire comparisons made on the basis of superficial and limited testing are of very little value. Complete tire evaluation takes in not only operating characteristics, but also the determination of tire durability which is a result of both internal and external operating factors and must be included in the testing program.

The area of mechanical strength and the study of the effects of internal heat in the running tire are the work area of the laboratory and indoor tire testing. Laboratory testing includes raw material and chemical testing, but specifically covers the static whole-tire test for dimensions and strength in the field of this discussion. This consists of mounting tests for dimensions and bead tests, contour measurements to establish both loaded and unloaded physical shapes, bursting tests, penetration bruise tests, and tests for fabric rupture. These tests, as with all tire testing both indoor and outdoor, do not have any recognized standard test for the tire industry, but are set up by each manufacturer using his own procedures and limits. The closest thing to standard tests are the government tire procurement specifications, but even these are for minimum requirements and are somewhat fragmentary.

Indoor tire testing, to differentiate from laboratory tire testing, moves into the dynamic phase of testing and primarily evaluates the effects of internal heat from hysteresis and centrifugal forces. Dynamic indoor tests are basically the same for all types of tires and attempt to duplicate the stresses and conditions which cause failure in consumer service. Such tests, however, do not usually duplicate consumer use patterns, but are designed to emphasize particular internal stress and temperature relations at the expense of balanced conditions, as shown in Table 1.

Static laboratory and dynamic in-

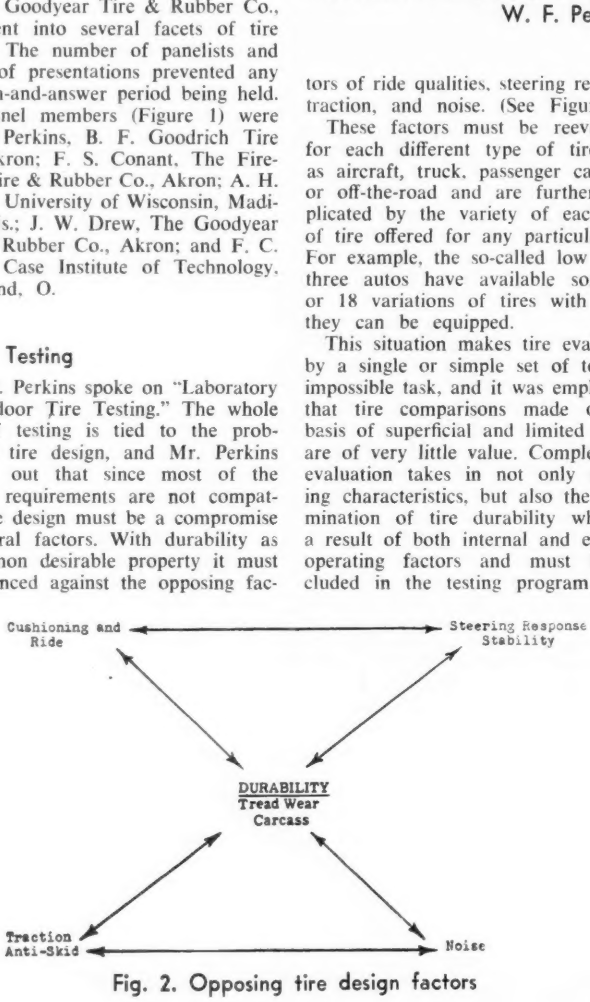


Fig. 2. Opposing tire design factors

TABLE 1. COMPARATIVE MAJOR DESIGN EMPHASIS

Type Tire	Durability		Stability	Load Capacity	Bruise Resistance	High Speed	Cushion and Ride	Traction Anti-Skid	Noise	Chemical, Weather Resistance
	Tread	Carcass								
Passenger										
Highway	A	A	B			B	B	B	C	B
Winter		B						A	C	
Truck										
Driver	A	A	C	B	B			B		
Trailer	A	A		B	B					
Off-highway	A	A		B	B			A		
Agricultural	C	B			B			A		D
Airplane		A		A			A			

A, B, C, and D are used as an arbitrary scale to assign priority to the design characteristics desired.

door testing are the volume source of comparative tire construction and tire compounding information. Except for tread wear, the effects of the weather, and the response of the tire to control stimuli, they offer the most reliable, quickest, and most controllable method of tire evaluation. Without the indoor machines, testing would be extremely expensive, with a resulting reduction in the information available to the designer and tire engineer.

The complete tire evaluation depends upon road testing, indoor testing, and consumer use experience and is used in the design of the tire with special emphasis as determined by the end-use of the tire, as outlined in Table 2. Static laboratory and dynamic indoor testing are one leg of the three for tire evaluation and are particularly important in the high-temperature and dynamic destructive forces areas of the evaluation.

High-Speed Photography

F. S. Conant made a moving picture presentation of the use of a high-speed camera (up to 3000 frames per second) in observation of product performance, experimental studies, and material processing in the rubber industry, with emphasis on tire testing. Features included tread wave motion, landing of airplane tires, tires on cleated drum, tires cornering on a test drum, and some observations of processing machinery and laboratory tests.

The film also showed the use of high-speed photos in measuring such tests as axle motion on cleated drum, tire cord breaks, and impact speed on solenoid-type low-temperature brittle point apparatus. Some of the techniques were given, and suitable applications as well as limitations were pointed out.[1]

Winter Tire Testing

A. H. Easton, chairman, committee on winter driving hazards, National Safety Council, Chicago, Ill., and professor, civil and mechanical engineering, University of Wisconsin, Madison, Wis., gave a presentation on the methods, places, and results to date of testing tires on snow and ice. The first testing was undertaken in 1934 by Prof. Ralph A. Moyer, of Iowa State College, and five years later was taken over by the newly organized NSC committee on winter driving hazards. Professor Moyer was the first chairman of this committee.

The first tests were conducted on Lake Calhoun near Minneapolis, Minn., in 1939. In 1940 and 1941 the tests were shifted to Lake Cadillac and Lake Houghton near Roscommon, Mich. After being interrupted by the war the tests were resumed upon an invitation by the Four Wheel Drive Auto Co., Clintonville, Wis., for the committee to conduct tests on Pine Lake near Clintonville. This action has resulted in the title "skid capitol of America" being applied to Clintonville. A typical test site on Pine Lake is shown in Figure 3 and consists of a ¼-mile straightway with 400-foot diameter circles at each end. The snow testing has been carried out at Land-O-Lakes airport where snow has been more prevalent and lower temperatures are generally the rule.

For tire testing on ice the lake surface is prepared by removal of snow as soon as the ice will support a jeep or other light vehicle. The ice thickness should be eight inches for this work. A truck plow may be used when the ice is 14 inches thick. A straight truck fully loaded may operate on 24-inch thickness, and this will also support loaded articulated trucks if care is taken to keep the vehicles moving. The depression of the ice around the loaded area will develop cracks in time, and repeated loadings must be avoided. If the ice is not smooth after snow removal, sweeping, planing, and water sprinkling may be used to improve the surface.

Snow test surfaces are more difficult to obtain and to make consistent since there are so many gradations of a snow surface. The definition used by the committee for hard-packed snow surface is one in which the crystals adhere to each other, but the surface is not glazed. This type of surface can be best maintained by using a grader to remove glaze caused by the testing. Deep snow is even more difficult to duplicate in testing. An ideal situation is one where the snow would range from three to 20 inches in depth in about 500 feet distance, with enough

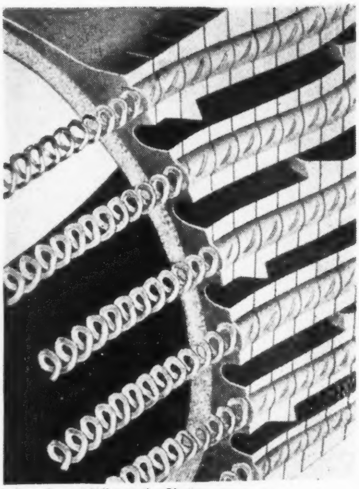
TABLE 2

Type Testing	Advantages	Disadvantages
Consumer experience	Actual service record Widest experience spectrum of drivers, climate, vehicles	Slow Difficult to obtain Requires large samples
Expedited field tests	Variety of climates and equipment	Limited application areas Relatively slow Requires large samples
Expedited controlled road tests	Quickest of road evaluations Controlled loads, speeds and routes make direct comparisons more accurate Measure tread wear	Expensive Narrow experience spectrum Expedited conditions may give shaded comparisons Weathering and aging are unobtainable
Indoor machine tests	Quick Complete control ambient temperatures, loads, speeds, inflations Relatively inexpensive No traffic or other interruptions	Cannot evaluate tread wear or natural weathering Artificial conditions sometimes accent difficulties beyond practical limit and sometimes give false results Usually set up to evaluate one tire quality

[1] RUBBER WORLD 138, 3, 428 (1958).

University of Wisconsin Photo

Fig. 3. Winter hazard testing site at Pine Lake, Wis.



University of Wisconsin Photo

Fig. 4. Embedded metal wire inserts in tread

area to allow that no two tests would be run in the same area.

Three means are used to evaluate tires and traction devices: namely, braking, traction, and cornering. The straightway (Figure 3) is used for braking and traction, and the 400-foot circles for cornering. For braking, the criterion still used is the distance traveled after the stop-light switch closes on the vehicle with wheels locked at 20 mph. The driver gets up to about 22 mph. and then is ready to apply brakes at 20 in deceleration. Three runs are made, and results within $\pm 5\%$ are accepted.

Traction is determined by towing a holdback vehicle by means of a drawbar dynamometer. Three types of test are run. Stall or static tests include holding the test car and applying power until tires break loose and spin. Dynamic traction is measured while both vehicles move at 2.5 mph. Spinning traction is measured with both starting at 2.5 mph, but the drive wheels on test revolve at 7.5 mph. or a slip of 200%. Cornering is tested by driving the 400-foot circle at increasing speed until the tires slip sideways.

Tires and traction are rated in terms of the regular or highway tires furnished as original equipment on the vehicle. Since temperature makes a difference, the best test condition has been set at 20-30° F.

Some typical test results are included in Table 3. In Section A the laceration is accomplished by operating the tire on rollers which have small radial projections which pierce the tread $\frac{3}{16}$-inch deep and provide almost innumerable lacerations around the tire. Section B lists tires cut or siped in regular intervals to the depth of the tread root by cutting or molding. The knobby type is compared in Section C. This works on snow, but is not too good on ice.

Section D gives the results of tread with wire coils embedded in it. The wearing of the tread leaves two points of metal sticking out for traction. The latest of these types uses a serpentine tread form to keep points distributed across the tire (Figure 4).

Section E shows results of three tire additives. Regular tires with both round and reinforced chains are given in

TABLE 3. COMPARATIVE RATINGS OF PASSENGER-CAR TIRE TRACTION
Test Tires on Rear Wheels

Tire	Ice, 20-25° F. Driving	Ice, 20-25° F. Braking	Ice, 20-25° F. Cornering	Hard-Packed Snow Driving	Hard-Packed Snow Braking
		Section A Laceration			
Regular	100	100	100	100	100
Lacerated	157	120	109	134	128
		Section B Siping			
Regular	100	100	100	100	100
Siped	147	111	106	140	123
		Section C Tread Pattern			
Regular	100	100	100	100	100
Knobby	105	100	102	126	129
Continuous bold	140	122	106	171	133
		Section D Embedded Metal Inserts*			
Regular	100	100	100	100	100
Wire inserts	172	111	110	147	116
Wet ice	266	124	—	—	—
		Section E Tread Additives			
Regular	100	100	100	100	100
Salt in tread	123	111	107	107	106
Peanut shells in tread	96	101	101	73	90
Sawdust in tread	100	103	—	89	99
		Section F Tire Chains			
Regular	100	100	100	100	100
With round chains	331	197	†	—	130
Reinforced chains	509	253	†	413	158
		Section G Sanders			
Regular	100	100	100	100	100
With Sander	370	116	—	132	100

* University of Wisconsin data. Serpentine rib.
† Limited by cornering ability of front wheels.

TABLE 4. LOCKED WHEEL STOPS

(On Ice-Covered Pavement from 20 Mph.)

Vehicle	Distances (Feet) Measured	Control Car	Adjusted*
Passenger car	190	190	190
4 × 2 Tractor and single axle trailer			
Empty (7800 GCW)	333	190	333
Loaded (40,950 GCW)	336	197	352
4 × 2 Tractor and single-axle trailer loaded (2+7)			
Chains on axle 2—thin ice	97	197	93
Thick ice	89	197	86
Chains on axles 2+3—thin ice	72	197	69
Thick ice	68	197	65
City bus			
Empty (15,770 GVW)†	318	189	316
Loaded (20,270 GVW)	370	235	299

* Adjusted to control car distance of 190.
† Average of two test series.

Section F. Reinforced chains are considered superior and are recommended. Section G shows results using sanders. In 1957 a test was set up to compare a 7.50-14 tire with a 6.70-15 size tire. Highway and mud-snow types were tested. In both types the 14-inch tire showed slight improvement. Other information obtained in this test showed that chains and mud-snow tires give 158% improvement or better, and it is the judgment of test drivers that the average driver would note and benefit from as little as 10%. The tests on tire pressure show that lower than suggested pressure gives poorer results, and higher pressure gives somewhat better results. As expected, an increase of weight over the rear wheels gave better traction results.

Table 4 shows the braking distance comparison between a passenger car and a truck tractor semi-trailer unit and also a city bus-car comparison, on ice. An explanation of the longer distance for the truck is based upon the unit pressure and heat build-up which is higher for the truck, leading to a more extensive water film around the truck tire.

Tables 5 and 6 give some test results of truck tires tested on ice and snow. Table 5 includes the data obtained with chains, and Table 6 those results obtained on different types of treads and wire-coil tires. While most of the tests were taken from data compiled by the committee work, some were obtained by the University of Wisconsin projects, and these truck tests were run as part of the University program.

Many more tests need to be run. New devices such as power brakes, power steering, automatic transmissions, brakes on different axles, brake synchronization, and brake application need to be evaluated for the effect they have on winter hazards. Studies also are scheduled on the stability of articulated vehicles and the driver technique effect on such vehicles.

Professor Easton, as chairman of the committee on winter driving hazards, congratulated the rubber industry for its wholehearted participation in this worthwhile program.

TABLE 5. UNIT CHAIN TESTS—TRACTION TEST

Vehicle: 4 × 2 tractor and tandem trailer with 10:00 × 20 tires

All tests were made on planed lake ice at a temperature of 30° F.

Tractive effort was measured by a strain gage drawbar between the test vehicle and the hold-back vehicle.

The wheels of the test vehicle were revolving at 10 mph. while the test vehicle was held to a ground speed of 5 mph. by the hold-back vehicle.

Type of Chains	Drawbar Pull Center-Lbs.	Rating
Tires without chains (average)	347	100
Four-unit chains outer tire only	1250	360
Type SH regular single chains outer tire only	1370	395
Type DTH regular dual triple side chains	2050	590
Type RS reinforced single chains outer tire only	2180	628
Type RDT reinforced dual triple side chains	3240	935

Tire Noise Evaluation

J. W. Drew reported to the Group on the testing of tires for noise. The modern automobile has successfully eliminated most of its noises so that the tire has become a major offender in this respect. As a result of the work done to date, tire noises have been divided into five classifications which are distinct and separate in their cause and cure.

1. *Tire Whine.* This is the high-frequency tone or singing caused by tread elements contacting and leaving road surface.
2. *Tire Squeal.* This is a tire side-slip vibration. This noise is related to tire compounds, coefficients of friction, modulus, design, temperature, and tire pressure. It is air borne.
3. *Braking Squeal.* This is the high-pitch squeal heard upon excessive or sudden braking. It is also known as "peeling" when it takes place upon rapid acceleration.
4. *Road Rumble.* This is the result of road irregularities causing tire vibrations. It is influenced by tire construction and compound. This noise is transmitted through the car.
5. *Tire Thump and Roughness.* This is also the result of irregularities, but in this case is in the tire itself. It is transmitted through the metal of the car and is of a very low level and would be probably unnoticed if not a periodic sound.

Many of the tests on noise are made by using a tape recorder. The microphone may be located at or near the tire for squeal and is located in the car at ear level for rumble and thump. An operator with earphones leading to each wheel can be used also, but a warning is sounded here to be sure the operator has equivalent hearing in each ear. The tape record is not only useful owing to being able to save the sound, but by splicing the sounds of two or more tires on to the same tape a very dramatic demonstration of the differences can be shown. The need of evaluation by ear is very real, however, since tire whine is often only 10% of the total noise. The whine is of a very high pitch which is selectively picked out by the ear and makes the use of machine less desirable for comparative evaluation.

The study of squeal and whine is much more simple than the study of rumble and roughness. Much work has been done, and much is under way, but at this time no real satisfactory solution is in sight. The present attack on the problem is to develop the new improved electronic pickups, am-

TABLE 6. COMPARATIVE RATINGS OF FOUR TRUCK TIRES

Tire*	Wet Ice Driving	Wet Ice Braking	Loose Snow Driving	Hard-Packed Snow Driving	Hard-Packed Snow Braking
Regular	100	100	100	100	100
Wire coils					
Straight rib	171	110	—	—	—
Serpentine	464	172	166	117	131
Block-type tread	—	—	150	95	119

* University of Wisconsin data.

plifiers, and recorders so that they can duplicate the human ear in detecting and evaluating tire noises.

Test Reliability

F. C. Leone used statistical information to report on the reliability of tire testing. This speaker divided his discussion into four parts. The first is a self-survey of the tests as run in the individual plant. The second part went into the sources of variation in treadwear testing. The third part discussed a continual point of controversy: namely, a three-way tread or a one-way tread. Finally, some conclusions on what can be done for management in the area of tire testing were given.

In the first place an analysis of the tests must be made. Can we correlate the results of a test in Texas with a test in Akron? Suppose we run tests on fleets of taxis or buses in California, New York, and Florida. How well can we correlate these data? We must avoid just putting a lot of data together merely to overwhelm someone with a mass of information, Dr. Leone further declared.

What about the test vehicles? Naturally we try to get them as homogeneous as possible, but it is a dream even to suggest that this is possible. The term vehicle includes the car and the driver, with the combination a source of variation in data. The measuring equipment, along with the operator of such, is another point where we must conduct some self-examination, it was said. The variations possibly will prove amazing to anyone checking them. The overall control of the experiment with thinking on all of the factors involved must be considered as vital to the success of the project.

The use of a statistically and scientifically planned test is paramount. A planned test will often provide information in excess of that required and will at least match that from one not planned. Several questions can be asked in connection with the self-survey of your test plans. First, "When are you making your decision?" As soon as you might, or several days after the necessary information is available. Second, "What is the reliability of your data?" Finally, "Are your decisions correct?"

Several sources of error are easily listed in treadwear testing. The tester is one source, both the one who makes the test, and the one who ta' 's the data. A variation is exist .n two tires of the same composi.io.. This is the reason for using at least two tires in a test. Weather, position of the tire, rotation, or temperature are sure to add variations in the testing. This material along with pairing factors must be considered in the testing approach.

One of the industry controversies is the three-way tread *vs.* the one-way tread. Is the use of three different treads on one tire a fair report on any of the treads? The proof of the final result must be complete tires of the tread in question. Some points raised are the effects of different compositions within one tire; are any weaknesses imposed by putting together three different sections; and are we introducing some additional factors into the experiment?

The conclusions drawn are that now is the time to think over the whole road testing program—to look over the cost, time, and effort of these programs to see if the results are all we wish to get from them. If we are aware of all the factors, are we controlling these factors? The recommendation is made that a statistically designed program be set up, not necessarily a costly involved program, but one in the same range as the present, but with results which will mean more to those obtaining them, Dr. Leone said.

A dream for the future is one where the data will be available to management sooner because the test will be planned and the use of punch cards and automation will make these data more reliable and informative. Dr. Leone sums up his dream by stating it would be one in which we make use of: (1) the experience and the reasoning of the decision makers; (2) well-designed statistical experiments; and, (3) computing equipment for data processing. A tire testing program of this nature would give the manufacturer the information he is paying for in the expensive business of tire testing, this speaker concluded.

CALENDAR of COMING EVENTS

December 19
Chicago Rubber Group

January 12-16
Society of Automotive Engineers. Annual Meeting and Engineering Display. Sheraton-Cadillac and Hotel Statler, Detroit, Mich.

January 23
Akron Rubber Group. Sheraton-Mayflower Hotel, Akron, O.

Philadelphia Rubber Group. Poor Richard Club, Philadelphia, Pa.

January 26-29
Plant Maintenance & Engineering Show. Public Auditorium, Cleveland, O.

January 27-30
Society of Plastics Engineers, Inc. Fifteenth Annual Technical Conference. Hotel Commodore, New York, N. Y.

January 30-31
Southern Rubber Group. Statler Hotel, Dallas, Tex.

February 2
Washington Rubber Group. Army-Navy Club, Washington, D. C.

February 2-7
Fifth Annual Tire Dealers' Management Program. University of Akron, Akron, O.

February 3
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

February 4-6
American Society for Testing Materials, Committee D-11. Pittsburgh, Pa.

February 6-8
Boston Rubber Group. Annual Ski Week-End. White Mountains, N. H.

February 12
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

March 3
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

Buffalo Rubber Group. Hotel Westbrook, Buffalo, N. Y.

March 16-18
Society of Automotive Engineers. National Passenger Car, Body, and Materials Meeting. Sheraton-Cadillac, Detroit, Mich.

April 6
Washington Rubber Group.

April 7
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

April 16
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

May 1
Buffalo Rubber Group and Ontario Rubber Group, CIC. Joint International Meeting. Hotel Sheraton-Brock, Niagara Falls, Ont., Canada.

May 4
Washington Rubber Group.

May 5
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.

May 12-15
Division of Rubber Chemistry, American Chemical Society. Biltmore Hotel, Los Angeles, Calif.

June 9
Buffalo Rubber Group. Golf Outing, Lancaster Country Club, Buffalo, N. Y.

Panel Discussion on Fluorinated Elastomers at Chicago Rubber Group

The meeting of the Chicago Rubber Group on October 3 was highlighted by a panel discussion of the subject, fluorinated elastomers. The meeting held at the Furniture Club, Chicago, Ill., was attended by more than 175 members and guests for the technical session at 5:00 p.m. and by more than 235 for the dinner. After dinner they heard a presentation on "Investing in Today's Market," by Gordon L. Teach, partner of A. C. Allyn & Co., Chicago, investment counsellor.

Moderator of the panel discussion was Earl R. Bartholomew, Chief of the Rubber Products Section, Materials Laboratory, Wright Air Development Center, Dayton, O. Panel members were Warren Bickel, of Douglas Aircraft Corp., Santa Monica, Calif.; T. D. Eubank, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.; T. D. Talcott, Dow Corning Corp., Midland, Mich.; and Lester E. Robb, of the Jersey City chemical division of Minnesota Mining & Mfg. Co., St. Paul.

Before introducing the panel members Bartholomew stated that this time was the first that representatives of all three fluorinated elastomer producers were present at one meeting to discuss properties of these new products which are playing such a vital role in our modern military weapons.

It is unquestionably true that we could not have the aircraft and missiles we have today without fluorinated elastomers, Mr. Bartholomew said. With the military aircraft and missile program known to exist and be under development at the present time, we can expect that military use of such rubbers will increase markedly in the future.

Another large use which is in the offing is in cars and trucks. There are many oil seals which should logically be made from these polymers. A great deal of development work is under way, and when it is finished and the automotive manufacturers start using the products, it can be expected that the result will be a substantial increase in volume of the polymers which will no doubt make it possible for the producers to make further reductions in price.

Fluorinated Polymer Panel Talks

F. Warren Bickel, Douglas Aircraft Corp., stated in his talk that it is no accident that the most immediate applications for the fluorinated elastomers have developed in the aircraft industry. The industry has always had top performance as its primary goal, and cost has not been a deterrent in improving present aircraft and the development of better planes. The fluorinated elastomers with their resistance to high temperatures, solvent and chemical resistance, flame resistance, and good all-round weathering have been the answer to many problems in the industry, particularly with the advent of jet planes where the requirements are much more severe.

At Douglas Aircraft all the presently available fluorinated elastomers have been used in one form or another. Silastic LS-53[1] has much to offer in low-temperature flexibility without the use of plasticizers. Also, high-temperature resistance as well as resistance to most oils is outstanding for this polymer. Viton[2] and Kel-F[3] provide resistance to higher temperatures than can be obtained with neoprene or butadiene-nitrile synthetics and also provide better flame resistance. Other fluorinated polymers have been screened, and there is much to recommend some of those now under development—such as the fluorinated polyesters.

In general, the fluorinated elastomers present a number of unusual processing problems not found with other synthetic elastomers. They are somewhat dry, and it is difficult to build uncured stock so that molding can take place. This drawback can be improved somewhat with plasticizers. When working with these polymers, it is wise to pay particular attention to the manufacturer's instructions, particularly the booklet on Viton put out by Du Pont, since this is quite complete in discussing the special handling and compounding problems encountered, the speaker said. For laboratory evaluations, it is suggested that a smaller laboratory mill be employed so that minimum-size batches may be mixed.

One application in which the fluorinated elastomers were especially helpful was on an airplane boot which had formerly been made of neoprene. It had good oil resistance, but cracked in the stratosphere. Other applications have been successful when the fluorinated polymers have replaced silicone rubbers in parts which had to withstand nicking and abrasion. In still other parts the good abrasion resistance, resistance to abuse, and good all-round weathering have permitted a lower-weight part to be designed; consequently there has been an overall decrease in cost although the fluorinated polymers are much more expensive than the elastomers they have replaced.

A dump-chute system seal was a problem in design for two years. Nitrile rubbers were tried, but they cracked and ozone checked. Neoprene was satisfactory for some planes, but was not resistant to accidental spraying of the part by mineral oil or Skyrol fluid. The fluorinated elastomers with special compounding proved completely satisfactory. With the new Douglas DC-8 no effort has been spared to make it the safest aircraft that can be built, and this has meant many parts are being fabricated from these new polymers.

The aircraft industry is most happy to cooperate in every way with suppliers to aid them in compounding and designing parts for better planes. Elimination of one pound of weight is worth at least $5,000 in the development of a new plane or the redesign of a part for a present plane.

T. D. Eubank, E. I. du Pont de Nemours & Co., Inc., the second speaker, pointed out that Viton is a fluoro elastomer developed to meet the challenge of rising temperatures in aircraft, automotive, and industrial mechanical goods. Its Mooney viscosity is comparable to that of conventional elastomers, and it processes readily on standard rubber equipment. Viton vulcanizates combine excellent heat resistance up to 600° F., with resistance to many fluids including aromatics, chlorinated hydrocarbons, and chemical solutions.

Viton commanded wide attention during its initial sales development from precision molders. O-rings and small seals are typical applications. Viton has served well for critical seals where combined heat and fluid resistance are necessary.

The usual curing of a Viton compound begins with 30 minutes in a press at 300° F. This is followed by a step cure of 16 to 24 hours at 400° F. in an air oven. The purpose of these comments is to point out why it is so, and what modifications can safely be made.

Air is very soluble in this fluoro elastomer. Air dissolved or trapped during mixing will be expanded and expelled during cure. To insure that the expansion and diffusion of air through the stock does not cause blistering, Viton is first given a short cure under pressure. During this press cure modulus is developed sufficient to enable the stock to resist fissuring in the higher temperature postcure. The purpose of the step cure prior to the 400° F. cure is to prevent too rapid expansion of air. The step cure permits the slow diffusion of this air while the Viton is at a temperature low enough so that it retains the modulus necessary to resist fissuring.

The 400° F. postcure has been found to give the optimum combination of

[1]Dow Corning Corp., Midland, Mich.

[2]Linear copolymer of vinylidene fluoride and hexafluoropropylene. E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Wilmington, Del.

[3]Polytrifluorochloroethylene, Minnesota Mining & Mfg. Co., Jersey City chemical division, Jersey City, N. J.

good original physicals, including compression set resistance, and excellent heat aging characteristics. For applications where extreme temperatures will not be encountered, such as in coated fabrics for protective clothing or hose linings, a considerably less rigorous postcure is permissible. Recent tests have revealed that uncured Viton compounds exposed to aromatics at room temperature and to boiling water swell no more in volume than fully cured samples. In most applications the poor compression set resistance of an uncured compound will not be permissible. However, as little as 8 to 24 hours at 300° F. will develop a vulcanizate with only 35% compression set after 70 hours at 250° F., a perfectly acceptable value for many applications.

Considerable interest has been expressed in Viton as a liner for hose carrying corrosive chemicals and steam. Recent data obtained show that it can be compounded for steam resistance. The best steam resistance is obtained when acceleration is kept at a minimum in this case by the elimination of Copper Inhibitor 65[2].

Viton A[4] hose has been fabricated using fully cured Viton tubes as a liner with an uncured neoprene friction and cover. Adhesion is obtained between the Viton liner and neoprene friction with successive coats of Chemlok 607[5] and Chemlok 220[5]. The assembled hose is wrapped and cured for 30 minutes in 60-pound steam to produce the finished article. Where compression set resistance is not required in the liner, an uncured Viton tube could be used in similar fashion, eliminating the need of any high-temperature cure. Hose tubes for steam service including pile driver hose, hydraulic aircraft hose, and hose for handling hot asphalt and high energy fuels are areas of typical interest for Viton.

Industrial rolls have also been successfully fabricated. Calendered Viton sheet about 20 to 30 mils thick is built on to a steel core coated with Chemlok 607. No solvent wipe of the calendered sheet is permissible because of the danger of trapping solvent in the uncured roll. Ply adhesion is obtained from building the calendered sheet up under pressure. The most satisfactory stock for rolls is a compound containing magnesium oxide without Copper Inhibitor 65 which has been found to impair core adhesion. Viton rolls command interest for hot film processing and metal handling and for high-temperature squeeze applications, particularly in contact with oils and solvents.

Viton has demonstrated excellent resistance to volume swell and loss of physical properties in transmission fluids, rear axle oils, and the new combination automotive fluids called transaxle fluids. Specimens were immersed in the oil for seven days at 350° F. Swells were in all cases less than 10%, and retention of both elongation and tensile strength greater than 80%.

T. D. Talcott, Dow Corning Corp., in discussing fluorosilicone elastomers said that little over two years ago an entirely new type of fuel and oil resistant elastomer was introduced. This new elastomer is a hybrid containing the familiar Si—O—Si—O backbone of silicone rubber, but having entirely new side groups in place of the methyl or phenyl side group used in conventional silicone rubber. The special side groups are of the fluoroalkyl group, which introduce into this elastomer an exceptional and unequaled combination of resistance to aviation fuels, oils, solvents, and both extremes of temperature.

This elastomer was developed by Dow Corning in conjunction with the Materials Laboratory of Wright Air Development Center, specifically to meet the ever-growing demands of the rapidly advancing aircraft, defense, and consumer industries.

Sealing of fluids at the extremes of temperature is becoming a severe problem in many industries in applications where conventional elastomers are not suitable. Fluorosilicone rubber has exceptional resistance to both high and low temperatures, characteristic of silicone rubber, and the solvent resistance associated with the fluorocarbons.

The elastomer, which is supplied as a fully compounded rubber, is called Silastic LS-53. It possesses sufficient strength to make all types of seals and gaskets. The typical physical properties which can be expected from this rubber cured for 24 hours at 300° F. are: Shore A durometer—55; tensile, psi.—1000; elongation, %—170; compression set %—22 after 22 hrs. @ 300° F.

The heat aging characteristics compare favorably with the conventional silicone elastomers. After aging 13 weeks at almost 500° F., about half of its original strength is retained.

The effects of solvents and other immersion media on Silastic LS-53 and regular silicone rubber can be shown by a few selected solvents. The effects are not merely reversed. Media may swell one and not the other, neither, or both. As examples—aromatic solvents like benzene and toluene, aliphatic solvents like gasoline, and even the chlorinated solvents like carbon tetrachloride or chlorobenzene, swell Silastic LS-53 very little, but swell regular silicone rubber more than 150%.

Ketones, such as acetone and methyl isobutyl ketone, swell Silastic LS-53, but have little effect on general-purpose silicone rubbers. Low molecular weight alcohols are detrimental to neither. The lower esters, such as butyl acetate, swell both types of silicone elastomers.

The fluorosilicone elastomer possesses good properties when exposed to fuels and oils at elevated temperatures. Fuels like JP-4, lubricating oils of the MIL-L-7808 diester type and aircraft hydraulic fluid are usable with fluorosilicone rubber from —80 to about +400° F.

The low-temperature properties of fluorosilicone rubber are good; in fact, slightly better than conventional dimethyl silicone rubber. Its brittle point is —90° F., but the stiffening temperature is —78° F. These low-temperature characteristics of an elastomer intended for sealing applications are often as important as sealing at higher temperatures.

The low-temperature properties are obtained in all silicone and fluorosilicone rubbers without the aid of plasticizers. This means they cannot lose their excellent low-temperature properties by solvent extraction when exposed to fuels, oils, or solvents.

During the two-year interval since the first fuel, solvent, and oil resistant silicone rubber appeared, many applications have proved very successful using Silastic LS-53. Applications involving contact with jet and aircraft fuels are many. They involve packing for fuel valves, seals in fuel system connectors, access door seals, and other miscellaneous gaskets. Brake cups are being used in contact with aircraft hydraulic fluids, and diaphragms are used in oil regulators. Silastic LS-53 is also used in the sealing of silicone fluids in applications ranging from electronic and electrical equipment to vibration damping devices. These are consumer applications as well as military.

Many fabricators and users of rubber parts are currently using considerable quantities of fluorosilicone rubber. With this quick acceptance of the elastomer and with evaluations for new applications continuing, a bright future is seen for elastomers of the fluorosilicone type.

Lester E. Robb, Jersey City chemical division, Minnesota Mining & Mfg. Co., emphasized that the development of fluorinated elastomers was a direct outgrowth of the work done starting in the late 1930's on the polymerization of fluorinated olefins to produce plastics such as Teflon[6] and Kel-F. The building blocks of these polymers are the fluorinated methanes and ethanes which are most familiar to the layman as refrigerants and aerosol liquids. With heat they react to form active unsaturated compounds such as vinylidine fluoride.

The low molecular polymers of such olefins tend to be oils, and the higher molecular weight polymers are usually crystalline polymers such as Teflon and Kel-F, which have sharp crystalline

[4] Viton A is currently furnished in two grades. A is in the Mooney viscosity range of conventional elastomers; while A-HV is about three times higher.
[5] Lord Mfg. Co., Erie, Pa.
[6] Polytetrafluoroethylene, Du Pont.

melting points. To obtain elastomeric properties it has been found possible to copolymerize two compounds such as chlorotrifluoroethylene and vinylidine fluoride. If the hardness of such a polymer is plotted against the percentage of the two ingredients, an eutectic-like curve is obtained, and the region where there is almost equal quantities of the two compounds present is the region where the hardness is low and the elongation high—or where the rubber-like properties are to be found.

By choice of the proper starting olefins it has been found possible to shift the rubbery range to a lower temperature and still keep the high thermal resistance and chemical resistance. Perfluoropropene and vinylidine fluoride, when copolymerized, have given good low-temperature properties and room temperature flexibility similar to that of the vinyl resins.

One of the improvements which can be expected as we gain more experience with these elastomers is the designing of a polymer for each desired property. For example, we know that thermal stability is enhanced by saturation of the polymer, oxidation stability by a high fluorine content, and chemical resistance by as high a fluorine substitution as possible.

Some of the short-range goals of the fluorinated elastomers are to improve the low-temperature flexibility which will probably be done by structural modifications, to obtain better and safer cures as well as design specific compounds for specific applications which can be accomplished by compounding developments, to lower costs so that more general applications can be achieved, and to develop the necessary modifications such as latex and liquid elastomers for sealants. For the longer-range improvements it will probably be found that major structural changes such as the introduction of atoms other than fluorine into the polymeric chain will be necessary.

Questions and Answers

Q. What volume of fluorinated elastomers is used in aircraft?

A. Bickel. Each new Douglas DC-8 contains more than 28 pounds of such polymers.

Q. The best press cure for Viton was described as 30 minutes at 300° F. What would be the properties of a 15-minute cure?

A. Eubank. The only real requirement is that the part reach 300° F. This is a matter of heat transfer and depends on size and shape of the molded item.

Q. Which of these elastomers can be cured in open steam?

A. Eubank, Talcott, and Robb. Both LS-53 and Viton can be cured in open steam, and Kel-F can be also if the amine cure is used.

Q. How can I get thin flash of Viton off the mold?

A. Eubank. Viton adheres to a clean mold. We suggest you use a conventional mold lubricant.

Q. Discuss adhesive systems for fluorinated elastomers to metal.

A. Robb. The two basic systems are Chemlok 607 which has a silicone base and provides fair strength, and an epoxy adhesive with a polyamine curing agent which attacks the polymer and ties the polymer to the metal.

A. Eubank. The problem is one of the difference in thermal expansion of the metal and the polymer due to the very high temperatures experienced. On most bonds there is a great deal of stress, and by the nature of the polymer the bond is weakened by increase in temperature. Viton cements have been made, but there is still room for improvement. Chemlok 607 is used satisfactorily.

A. Talcott. For LS-53 we recommend Chemlok 607 and Silicone Primer 4049 for sticking to metal. For adhesion to textiles we have made a solvent dispersion of the elastomer.

Q. Why is Copper Inhibitor used in Viton?

A. Eubank. Magnesia cures give better heat resistance, but they are very scorchy. Copper Inhibitor has been found to be a good retarder for Viton, and at curing temperature it activates the cure.

Q. How about a straight Copper Inhibitor cure for Viton?

A. Eubank. It would be necessary to use a higher temperature—probably too high for practical application. Also, the cured polymer would have poorer heat resistance.

Q. How about higher heat resistance in the future?

A. Bartholomew. With polyperfluoroamidines it is possible to go to 780° F. with only 3½% loss in weight and little change in properties. We may expect to get 800 to 900° F. resistance in the near future and even 1000° F. resistance some day.

Q. What are some of the non-aircraft applications?

A. Eubank, Talcott, Robb. One heavy-duty truck engine uses fluorinated elastomers for a valve stem seal. Other applications are for protective clothing, oil seals, and valve linings for the auto industry, and miscellaneous parts for furnaces or room heaters.

Q. How can Viton's low-temperature properties be improved?

A. Eubank. Considerable attention has been and is being devoted at the Du Pont laboratories to finding a plasticizer which will improve Viton's low-temperature properties. To date not much success can be reported. The major problem appears to be loss of the plasticizer by volatilization in the post-cure. To some extent Viton's ability to perform at low temperatures is affected by the thickness of the specimen. Very thin wire coverings have flexed without breaking at -90° F. Viton O-rings have passed temperature cycling tests at -65° F. It is possible there is a conditioning effect of the fluid in which the Viton O-ring is immersed which promotes flexibility at the low temperature.

Ontario Group Holds First 1958-'59 Meeting

The Ontario Rubber Group held the first dinner-meeting of the 1958-1959 season at the Pickfair Restaurant, Mimico, Toronto, Ont., on October 14. The dinner was preceded by a cocktail hour sponsored by Dow Corning Corp., Midland, Mich.

A plaque was presented to Wray A. Cline, immediate past chairman, on behalf of the entire membership as "a small token of their deep appreciation of his tireless efforts for the Group during his term as chairman." Carl Croakman, present chairman of the Group, announced that the rubber technology course being given at the University of Toronto was oversubscribed.

Paul Oppliger, fluids section, product engineering laboratories, Dow Corning, spoke to the Group on "The Use of Silicones in the Rubber and Plastics Industry." The paper covered such uses as mold release, coatings, lubricants for rubber parts, additives to urethane foams and deaerate or anti-foam properties on plastisols.

Buffalo RG Meeting Hears F. M. O'Conner

The fall meeting of the Buffalo Rubber Group was held October 14 in the Hotel Westbrook, Buffalo, N. Y., and was attended by about 100 members and guests. The technical paper presented was an expansion of his reports on "Recent Developments in Chemically Loaded Molecular Sieves" originally given before the Rubber Division meetings in Cincinnati, O., and Chicago Ill., by F. M. O'Conner, of the Linde Division of Union Carbide Corp., Tonawanda, N. Y.[1]

The speaker following the banquet was W. I. LaTourette, senior research analyst, Shearson, Hammill & Co., New York, N. Y., who discussed "Investment and Economic Aspects of the Stock Market as related to the Chemical Industry." He spoke on the effect of tariffs, quotas, and other government actions on the fiscal policies of companies and the effect of these policies on market performance. A 45-minute question-and-answer period following the talk was indicative of the interest that was evoked by Mr. LaTourette's discussion.

[1] RUBBER WORLD, June, 1958, p. 424.

Automation in the Millroom Discussed At Detroit Group October 3 Meeting

"Automation in the Millroom", a talk by Richard W. Fuller, of Farrel-Birmingham Co., Ansonia, Conn., was the featured item of the technical session at the Detroit Rubber & Plastics Group fall meeting on October 3. Highlight of the after-dinner session was Gus Mortson, defenseman on the Detroit Redwings hockey team. He spoke on the prospects of the new season and showed movies of the highlights of the finals series of the Stanley Cup Playoffs in 1958 between the Montreal Canadiens and the Boston Bruins. Mortson is a veteran of 12 years in the National Hockey league, having played with Toronto and Chicago before joining the Detroit team this year. He gave a very candid inside look into a player's comments and opinions of the sport.

In the technical session Mr. Fuller presented his views on what can be expected in the mixing and processing of rubber compounds in the future. He stated that while many changes can be expected and that new equipment is being developed, the basic Banbury, mill, extruder, and calender will not be replaced, but will be revised for greater speed, efficiency, and economy. The major effort will be made in the feeding and removing of the materials by mechanical means with the advent of the high-speed and high-pressure internal mixers. As an example, the use of slab extruders and pelletizers in place of batchout mills was cited.

Many developments are the result of specialized plants or processes and can be then utilized by the industry in general. The development of the calender is a case in point. When the plastics industry first started using the rubber calenders, they found that they were not entirely satisfactory and began to modify them for the more exacting use. Now the rubber industry is beginning to adopt some of the changes made to the calenders for plastics, and the use of these improvements by the rubber industry is expected to grow as time goes on.

The use of many of these innovations need not wait for some distant "day of automation." Already many of the larger users of rubber machinery have installed automatic weighing, feeding, timing, and removal systems in the mixing areas. It has been felt, however, that this is not always feasible for the small user. The development of the more economical and flexible system which can be used by the small operation is now in demand.

A recent installation by Farrel-Birmingham in a small plant is used as an illustration of what can be done. The company first installed a Uni-drive Banbury for mixing highly loaded stock. It was found that the higher horsepower and improved mixing techniques reduced the cycle to about three minutes. At this speed the compounders were having difficulty keeping up with the machine, and quality was suffering owing to variances in the weighing and cycling.

The solution was an automatic weighing system. Since the area had no second floor and conveyors were not justified as an expense, a mezzanine was constructed six feet off the floor so that skids of material could be delivered by lift truck for manual transfer into the hoppers. The ingredient hoppers were so located that materials requiring almost constant loading were close together, and those which were small weight per batch were together for attention less frequently. The batch required 12 ingredients plus the rubber, a premixed color, and one oil. Nine ingredients which needed hopper refilling only every two hours to 16 hours are located in one line, and the other three, where hopper refilling was required almost constantly, are located in another line.

With the ingredients automatically weighed by individual scale units the operator needs only to weigh the rubber, and he has a small hydraulic guillotine to assist him. He also places the package of pigments which is preweighed by the control laboratory, on the rubber. The only other additive is the oil which is delivered by an automatic pump from an underground storage tank to a nozzle built into the thermocouple opening into the body of the machine. While this is not a completely integrated automatic system, it does show what can be done at reasonable cost in a small plant to help in eliminating some of the labor costs of mixing.

With mixing cycles becoming shorter, a need is being generated for faster batchout procedures. It is felt that the screw-type machine will replace the mill in this operation since it is next to impossible for a man on a batchout mill to keep up with mixing cycles which are dropping as low as 20 to 30 seconds. This type of set-up is being adapted particularly by the wire extrusion units where an internal mixer coupled with a strainer-extruder meets the need of fast action for wire insulation extrusions. The normal procedure is to mix in the Banbury and drop into the strainer extruder from which strips are run out and cooled. The stock is returned to the Banbury for the addition of sulfur and then run back through the extruder with the strainer removed and the proper die for the finished product substituted.

Another machine for this stage of manufacture is the pelletizer. It is generally less expensive in many respects, runs cooler for better stock control, and provides material in a form which is well suited to automatic weighing and handling. The disadvantage still to be resolved in pelleted material is that of storage. It is necessary to limit the depth of pellets to two to three feet or less in storage bins to keep them in a free-flowing form.

It can be said that the "mill room of the future" is in fact already undergoing the long slow process that will lead eventually to the mechanical marvels of automation.

Northern California November Meeting

The Northern California Rubber Group held a technical meeting on November 13, with the major speaker being Ross E. Morris, of the Mare Island Rubber Laboratory, whose topic was "The Effect of Nuclear Radiation on Rubbers." The meeting was held at the Berkeley Elks Club, Berkeley, Calif., with a social hour, dinner, and business meeting preceding the speaker.

Committee Chairman George Farwell, Goodyear Rubber Co., reported the names submitted by the nominating committee and announced that the ballots were in the mail, and the new officers would be installed at the annual Christmas party, December 6, at the Orinda Country Club, Orinda, Calif. Keith Large, Oliver Tire & Rubber Co., is chairman for this affair.

Announcement was made of the completion on November 12 of a series of six seminars held under sponsorship of the Group. The weekly sessions were on: Statistical Control Testing, by C. A. Stephens, Federal Mogul-Bower Bearings Co.; Special Elastomers, B. W. Fuller, E. I. du Pont de Nemours & Co., Inc., and R. B. Stewart, Dow Corning Corp.; Hydrocarbon Plasticizers and Softeners, by D. M. Preiss, Shell Oil Co.; Reclaimed Rubber, M. A. McDonald, Midwest Rubber Reclaiming Co.; Antioxidants and Antiozonants, John Eynck, Mare Island Naval Shipyard; and Accelerators and Vulcanizing Agents, B. S. Garvey, Pennsylvania Salt Mfg. Co.

Mr. Morris, in his radiation-damage-to-rubber talk, described the work done to date, particularly on the study of compression set properties. He stated that the goal set for the project was to find a vulcanizate which would have less than 100% set after subjection to 10^9 roentgens. No such vulcanizate has been found so far, and Mr. Morris expressed the doubt that one of the current elastomers would meet this requirement. A more complete abstract of this work appears in the report on the fifth joint Army-Navy-Air Force Elastomer Conference held in Dayton, O., which begins on page 399 of this issue.

Liquid Elastomer Processing Described at Philadelphia Group

The fall meeting of the Philadelphia Rubber Group was held October 24 at the Poor Richard Club, Philadelphia, Pa., with a talk on a look into the future of elastomer processing being the main feature. About 135 members and guests attended the meeting, which also elected a slate of officers for 1959. R. A. Garrett, Armstrong Cork Co., chairman, conducted the meeting and announced that the officers would be: chairman, R. S. Graff, E. I. du Pont de Nemours & Co., Inc.; vice chairman, H. C. Remsberg, Carlisle Corp., Carlisle Tire & Rubber Division; secretary-treasurer, R. N. Hendrikson, Phillips Chemical Co.; and directors, Hank Smith, Naugatuck Chemical division, United States Rubber Co., and Dick Kerr, Para-Chemicals, Inc.

Announcement was made that the directory for the Group had been sent out to all members and that the membership of the group stood at 530 on October 24, 1958.

Ralph Graff, vice chairman, introduced Jack S. Rugg, division of fluid polymers, E. I. du Pont de Nemours & Co., Inc. who spoke on "Elastomer Processing—A Look into the Future." The rise of broadly serviceable liquid polymers has made the "mill" room of the future subject to a great change. The elastomer will arrive in tank cars and be piped into storage tanks. Automatic mixing machines will call for material as needed, and the mixed material will be dispensed automatically as the molds pass on a conveyor under the mixing nozzle.

Two reasons for great interest in these liquid elastomers are, first, they will result in large cost savings, and, second, liquid polymers will result in superior products with properties not available in other elastomers since they need not be hampered by a need of a plastic processable stage. In addition, there are several variables which control the polymerization of liquid elastomers, and these variables yield specific reproducible properties in the solid polymer. Thinking on liquid elastomers should not be limited to urethanes since polymer research can be expected to yield other high-quality liquid products.

In the liquid elastomer plant, processing costs are reduced by three means. Raw material and in-process inventories are cut down, capital expenditures for equipment are reduced, and the number of operations reduced.

The heart of the liquid polymer automatic process is the mixing machine itself. The mixing head is simply a chamber which encloses a helical rotor, and the polymer and curing agent are metered into the mixing chamber and thoroughly mixed. Excellent reproducibility of mixing, proportioning, and shot size have been obtained. The mixer is tied into the mold conveyor system by an electric eye so that it fills the mold as the latter stops under the mixing nozzle.

A line producing 100 pounds per hour operated by one man at the mold stripping station is envisioned. The filled molds will make a circular trip through an oven, be stripped, and return for refilling. Similar systems may be used for knife coating, roll coating, spraying, and possibly extrusion by the selection of the necessary equipment.

Figure 1 shows a simplified drawing of the steps in handling liquid elastomers. These five steps correspond to some 15 to 20 steps in a conventional dry rubber plant with many transportation and storage steps eliminated in the liquid polymer product plant.

At present the properties of the urethanes have suggested that they would be useful in molded items; so the first processing developments have been made in that direction. These properties were reported to the national meeting of the American Chemical Society's Rubber Division meeting at Cincinnati, O., May 14, 1958,[1] as they are obtained from Adiprene L.[2]

Along with conventional rubber molding methods the liquid elastomer adds some others to make six techniques available. They are casting, compression, transfer, injection, centrifugal, and rotational molding. The low viscosity and ease of flow along with the need of only enough pressure to insure the filling of the mold make these many types of moldings very interesting to the rubber manufacturer. Mr. Rugg concluded by saying that the future held much in the way of opportunities to those who are investigating the liquid elastomers.

[1] RUBBER WORLD, Apr. 1958, p. 92.
[2] E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Boston Elastomer Group Meeting Hears Lerner

The annual meeting of the Elastomer & Plastics Group, Northeastern Section, ACS, and the first of this season, was held October 21 at Science Park, Charles River Dam, Boston, Mass. In attendance were 75 guests and members who elected officers for the coming year and heard M. E. Lerner, editor, *Rubber Age*, speak on "Latest Developments in the Polymer Field."

Following the cocktail hour and banquet in the speaker's honor, the business meeting was conducted by Max Taitel, UBS Chemicals Co., retiring chairman. An executive committee vote to increase dues to $3.00 per year was approved. The list of nominations submitted by the nominating committee, John B. Gregory, F. S. Bacon Laboratories, chairman, was accepted without dissenting vote, and the officers for the coming year follow:

Chairman, J. Horace Faull, Jr., consultant; chairman-elect, James H. Fitzgerald, Harwick Standard Chemical Co.; secretary, Joseph M. Donahue, Goodyear Tire & Rubber Co.; treasurer, Henry A. Hill, National Polychemicals, Inc.; custodian, Henry S. Anthony, Tyer Rubber Co.; hospitality committee chairman, Elmer E. Ross, T. C. Ashley & Co. The new executive committee includes B. B. S. T. Boonstra, Godfrey L. Cabot, Inc. (to 1961), Juan Montermoso, Q. M. Research & Equipment Command (to 1960), and J. Laurence Powell, Goodrich Footwear & Flooring Co. (to 1959).

Dr. Faull, in opening the new year, outlined the program planned for the seven succeeding meetings and then introduced the speaker, M. E. Lerner, who gave a rapid survey of recent developments in the many types of polymers now produced in the world. Mr. Lerner showed how quickly advances were being made in the rocket

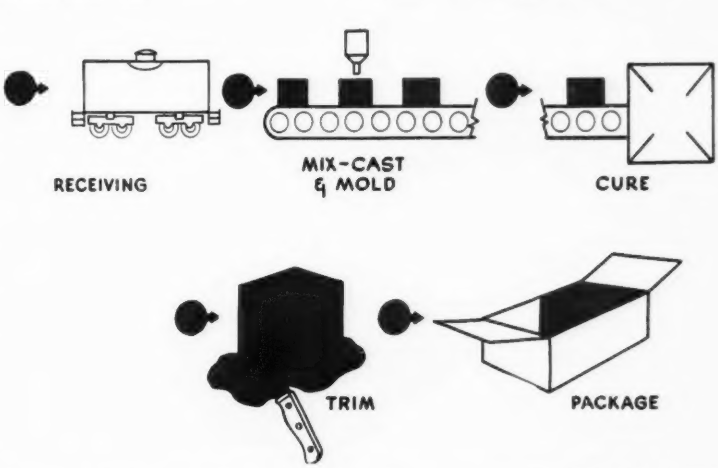


Fig. 1. Liquid elastomer processing. These five steps with fluid transportation correspond to 15 to 20 steps required for conventional solid rubber processing

age and how requirements were becoming harder to meet because of higher and lower temperatures; he then discussed the various polymer classes developed by science and their adaptation to many of these conditions.

Mr. Lerner described some of the butadiene rubbers recently announced in this country and told of the advantages claimed for chlorobutyl rubber, and of the properties of deutero rubber; then he discussed Thiokol polysulfide, neoprene, and polyurethane synthetic rubbers. Next the speaker took up cyanosilicones, epoxy organosiloxanes, vinyl silicones, and fluoropolymers, giving some of the advantages of each and where it was expected that they might find applications.

The following section of his speech covered block and graft polymers, including poly(methyl methracrylate)-styrene compounds, natural latex and polyethylene modified by gamma and ultra-violet radiation, and numerous other monomer-polymer combinations, including the work done on these materials at Brookhaven Laboratories, Brooklyn Polytechnic, MIT, in France at Courtauds, in England at the British Rubber Research Association, and at Kuala Lumpur, Malaya.

The speaker further discussed stereospecific polymers, covering the Ziegler and Natta compounds of varying tacticity, including acrylates and methyl acrylates. He compared the planar zig-zag structures of some polymers with the helical configurations attributed to tactic polymers and described recent work done on polymerization in noble gas atmospheres.

In concluding his talk Mr. Lerner tabulated the value of rubber ingredients utilized yearly and the relative amounts used. He stated his lifelong optimism for the rubber industry was as firm as ever, indicating the tremendous growth it had gone through in the last 50 years, and held out the same hope for the plastics industry after its ten-year development to today. Capital expenditures were the criterion of industrial development, he said, and are a useful barometer for progress in each industry.

In conclusion he quoted Dr. Killian, the President's scientific advisor, to the effect that the future of the West depends on the full and effective use of free-world resources and the flow of ideas, and cooperation, of free peoples, and to this he added—the high polymer field. In prediction of the future, Mr. Lerner admitted that no one knows where we will be ten years from now.

The next meeting of the elastomer & Plastics Group will be a field trip to the Owens-Corning glass plant, Ashton, R. I., on November 18, where a tour of the fiber glass plant will take place, a banquet will be held, and talks by several of Owens-Corning technical staff be given. Attendance will be limited to 100.

(Left to right) **Mayor Leo Berg of Akron; Russel De Young, president of Goodyear; W. A. Patterson; T. H. Rogers, president of ACESS; Milton Leonard, chairman, program committee; and J. E. Trainer, executive vice president of Firestone, during presentation of ACESS plaque to Mr. Patterson**

CIC Wants Papers

The Division of Rubber Chemistry, Chemical Institute of Canada, plans holding its 1959 annual convention at the Sheraton-Brock Hotel, Niagara Falls, Ont., on May 1, 1959.

There will be technical sessions morning and afternoon, and these sessions will include a symposium on "Aging and Weathering of Elastomers." This should offer considerable scope for discussion on any aspect referring to heat, oxygen, ozone and weather degradation of elastomers over a wide range of service conditions.

The Division, believing that this convention will be of interest to a great number of firms, is now soliciting original technical papers running approximately 30 minutes each. Firms interested in participating are requested to write J. A. Carr, chairman, Division of Rubber Chemistry, CIC, c/o Dunlop Research Centre, 870 Queens St. E., Toronto 8, Ont., Canada.

ACESS Holds Banquet

The Akron Council of Engineering & Scientific Societies (ACESS) held its annual banquet October 9 at the Sheraton Hotel, Akron, O. W. A. Patterson, guest speaker and president of United Air Lines, discussed commercial jet aviation. ACESS is composed of area members of the American Chemical Society, all of the professional engineering societies, and the American Institute of Architects—total membership exceeding 2,500.

Mr. Patterson told the group that orders totaling more than $1¼ billion in new jet equipment have been placed by the industry, even though this new equipment project heavily taxes the financial capacity of the airlines. United Air Lines alone is committed for $300 million for its new jets, which include the larger DC-8's and the smaller Boeing 720's. He indicated that they were looking for an intermediate jet to fill out the program.

United will have its first jets in service in September, 1959, and the initial run will be between New York and San Francisco.

The ACESS annual banquet attracted many of the well-known chemists and engineers of the rubber industry. There were 500 in attendance.

Following the talk a plaque was presented to Mr. Patterson from ACESS, honoring his outstanding service to commercial aviation over the past 40 years.

Has Trade Mark File

Cheminform Institute, New York, N. Y., has announced that a file of trade marks in the chemical and allied fields is now available for immediate use. A unique feature of this file is that it includes registered, unregistered, common, trivial, foreign, scientific, and technological names in every type of chemical and chemical using industry. In many cases the chemical composition or active ingredients, use of the product, and name of the manufacturer are given. This file is international in scope, serving the most important foreign countries in addition to the United States. Under the personal direction of H. Bennett, it has taken 15 years of continuous work to assemble and is being added to daily. Telephone or letter inquiries will bring promptly needed information.

WASHINGTON REPORT

By JOHN F. KING

Communist Europe Market Opens A Bit; Washington Feels Expansion Limited

Is there a market for American rubber products, machinery and production technology opening, ever so slightly, in Communist Europe? It is reasonable to believe that the United States rubber industry hopes so, if for no other reason than business instinct. But the United States Government, even though it is lifting a few of the barriers to the opening of such a market, doesn't believe the rubber industry, or any other American industry for that matter, should get its hopes up.

U. S. Government View

"The Soviets buy and sell for one reason and one reason alone," a top government official says, summarizing official policy of the United States on the Red trade question. "And that is to equip their economy to such a degree that they will never again have to depend on outside help. The goal of autocracy — complete economic self-sufficiency—always has been and always will be the keystone of Soviet policy."

The official believes that "one-shot" purchases by Russia of a piece of machinery or a technological process—in order to "lift" the specifications of the machinery or the technical formula required—is all the Soviets are interested in in their stepped-up campaign to buy and sell with the West.

This assessment squares with that of C. Douglas Dillon, the Undersecretary of State who has taken over as the top U. S. policymaker in its economic warfare with the Soviet Union.

Dillon believes we soon may be witnessing a "repetition" of the Soviet import-export campaign of the earlier Thirties, when the Russians entered the world market in a big way, buying up plant and machinery on a grand scale and employing western technology on a wholesale level. The Soviet "re-equipment" campaign of the Thirties was accompanied by a massive entrance into western markets in another way—dumping tremendous volumes of foodstuffs and primary commodities, as well as some manufactured goods, into western trade channels in order to finance the buying campaign. This dumping has occurred in recent months in a number of non-ferrous minerals markets. The Red Chinese have followed suit, dumping consumer goods in Asian markets.

Significantly for the American rubber industry, Dillon believes the new buying program of the Soviet Union will be focused on the petrochemical field. The Russians' interest there, he adds, "includes technology and equipment related to tire manufacture, certain types of construction equipment and mining machinery."

He bases his view on the recently announced seven-year plan, in which Soviet leaders "apparently have embarked on a major campaign to increase foreign purchases of equipment and technology for industries which they had hitherto neglected." He noted Nikita Khrushchev's statement that it will "be expedient to order part of this (new) equipment in the capitalist countries" to insure "quicker fulfillment of (the USSR's) program for the construction of new chemical enterprises without wasting time on creation of plans and mastering the production of new types of equipment."

Future Market Possibilities

Just what's involved in the rubber trade between the U. S. and Red Europe? (Trade with Red China of all types has been altogether prohibited since the imposition of the China embargo during the Korean War.) From the government's records it appears that very little is involved, but a recent relaxation by the Commerce Department of its export controls on a number of rubber products may change this picture. It all depends on whether Dillon's appreciation of the Soviets' aim is correct.

Removed from the list of goods for which the Commerce Department will require a special validated license before they may be exported to the European Soviet bloc are these items: crude natural and latex rubber; butyl rubber (copolymers of isobutylene and isoprene or other diolefins); polytrifluorochloroethylene elastomer (Kel-F); and high-pressure drilling hose (3,000 psi. test and over). Added to the so-called Positive List of goods which require individual export licenses at the same time are these items: copolymers of methyl vinyl-pyridine and butadiene; fluorinated and other silicone rubber compounds; silicone rubber insulating tape, sheet packing, and rubber packing; and other silicone rubber manufactures not specially classified.

During the third quarter of this year U. S. exporters won licenses to ship nearly half a million dollars worth of synthetic rubber and polyethylene to Poland. Licenses to ship small amounts of rayon tire yarn, hose, rubber peptizing agents, and various types of synthetic rubber and vinyls to the European bloc were approved as well. The total here does not exceed another half million.

In contrast to the small amounts of rubber goods currently involved in U. S. trade with the bloc, U. S. rubber product exports to Poland ten years ago were worth \$2.5 million, \$4 million to Czechoslovakia, and to Russia itself \$500,000. Exports to other less developed bloc countries were worth another \$500,000. All these countries, as well as Red China, appear currently to be buying large amounts of natural rubber.

Minimum Wage Hearings Produce Suggested New Rates; Industry Objections Recorded Again

The government has completed nine days of hearings, spread out through October and November, looking toward the establishment of a minimum wage to be paid by tire, tube, and camelback manufacturers on all Federal Government contract work as provided under the Walsh-Healy Act.

Filing of briefs by attorneys for labor and management, expected before the end of the year, will set the stage for a "preliminary" recommendation by Labor Secretary James P. Mitchell. If prevailed upon by subsequent "exceptions" to the initial finding by either of the contending parties,

Mitchell may modify his decision when issuing a "final order" setting a prevailing minimum wage for the industry next year.

Even the final order may be appealed in court, as well it might be. The rubber companies involved in the case have protested throughout the proceedings that the framework of the case, as determined by the Labor Department, is improper on a number of counts.

From $1.54 to $1.93 Suggested

In any event, the technical situation is this: The record in the case, compiled by a hearing examiner who acted as referee in the hearings and who will himself offer no recommendations, will go to Clarence T. Lundquist, Labor Department Wage-Hour Administrator. Lundquist, after study of the record and post-hearing briefs, will recommend to Secretary Mitchell prevailing minimum wage or wages—should differences in wage rates caused by geographic location be reflected in separate "regional" prevailing minimums.

The starting and ending points of Lundquist's search for a recommendation appear to be the $1.54 minimum rate suggested by counsel for the rubber companies and the $1.93 hourly minimum offered by attorneys for the AFL-CIO United Rubber Workers Union. Labor Department spokesmen caution, however, that the final order of the Secretary on prevailing minimums need not fall in between these two figures as a sort of compromise. The Walsh-Healy Act gives the government latitude to go outside the recommendations of contending parties for nationwide or regional minimums.

The $1.54 rate offered by management is based on the companies' interpretation of cost-of-living statistics prepared for the hearings by the Bureau of Labor Statistics. The URW's recommended rate, which actually is $1.85 plus 8¢ to reflect the recent across-the-board wage increase of that amount, is based on the union's interpretation of the same BLS statistics.

While URW went into the hearings strongly favoring the Labor Department's determination to promulgate prevailing minimum wages which tire and tube makers must pay on all government contracts over $10,000, the companies long have resisted the whole idea. Opposition of the companies goes back to the Korean War period, when the Department first began an investigation looking toward a Walsh-Healy minimum wage determination. This was dropped, but Labor again started proceedings in early 1957. The recent hearings are an outgrowth of the Department's 1957 decision to renew the probe.

Industry Objections

In the course of the hearings, industry spokesmen made the following points and objections:

(1) It was improper for the government to exclude tire repair materials from the definition of the industry. These materials are generally grouped together with tires, tubes, and camelback as a related product.

(2) Any minimum wage will have a more severe impact on plants which manufacture products in addition to tires, tubes, and camelback, as most rubber companies do. Application of a minimum wage in integrated plants to only those workers manufacturing products within the Walsh-Healy definition will be administratively "impractical." The companies contended the prevailing minimum will have to be applied to all employes in the plant, not just those working on government orders for tires, tubes, and camelback. The impact of the minimum on wage structures of such integrated plants, they said, will have substantial effects on that plant's competitive position in the industry.

(3) Wages now being paid in the industry rank among "the highest in any American industry," management spokesmen said. They maintained that they find no evidence that any government contract for tire and tube products has been secured or is likely to be secured on the basis of "substandard" wages.

Fourth and finally, in the event the Secretary of Labor issues his ruling, which is almost a certainty, the companies urged that the minimum wage should contain an exception, or "tolerance," to cover the practice in many plants within the industry of revoking all minimum wage guarantees for incentive-paid employes should there be a production "slowdown."

The united industry stand on these arguments was worked out in the hope of keeping the Walsh-Healy minimum as low as possible. A high minimum or minimums, informed industry spokesmen believe, will tend to push up URW's demands for higher wages in new contract negotiations. Should this prove true, the companies are said to fear the complicated incentive-pay systems widespread in the rubber industry could be riddled.

New Congress Probe On Tire Retailing

Senator Hubert H. Humphrey, a leader of the Senate's wing of northern liberals which is expected to have even more influence as a result of the Democratic election sweep, has opened a new investigation of tire retailing.

Even before the new Congress convenes, the Minnesota Democrat told the recent thirty-eighth annual conference of National Tire Dealers & Retreaders Association the oft-investigated question of competitive problems of independent tire retailers will get a thorough airing by his Senate Small Business Subcommittee on Retailing, Distribution, and Fair Trade Practices.

It is expected the Humphrey Senate probe will be complemented by renewed hearings on the issue by the House Small Business Subcommittee headed by Rep. James Roosevelt (Dem., Calif.). The Roosevelt Subcommittee in the last Congress delved into independent dealer complaints about competition practice of selling tires, batteries, and accessories at the retail level.

Humphrey told the NTDRA convention that his Subcommittee will give "particular attention" to the practice followed "by some rubber tire manufacturers of competing directly at the resale level with their tire dealer customers.

"We want to find out," he said, "how the big rubber tire companies are able to sell their products to large commercial buyers at prices less than the independent tire distributor's invoice cost. We also want to know more about those instances in which a manufacturer sells its tires through its company stores at prices below those charged independent dealers."

The Senator continued:

"We shall also inquire into the extent to which 'direct selling' by tire manufacturers is used to control resale prices and other aspects of the channels of distribution. Certainly it is a basic principle in our free enterprise system that no manufacturer should possess what seemingly amounts to an unlimited power to fix his customers' resale prices or to drive such customers out of business by underselling them."

Pinching the independent dealer as well as other small businesses in the nation are primarily the "inflated costs of doing business," Humphrey declared. Other "disadvantages under which small business has been laboring," the Senator said, are:

(1) "A ruthless competitive atmosphere (which) is stacking the cards against smaller companies."

(2) "An increasing concentration of economic power in the hands of fewer and fewer giant companies."

(3) "Our existing corporate tax structure (which) places a heavier burden on small concerns than on giant corporations," and

(4) The fact that "many qualified small companies are unable to obtain sufficient capital to permit them to finance their growth and expansion at rates of interest and on terms they can afford."

Senator Humphrey's new investigation of tire retailing is only one of the several in the field of business regulation being planned by the new Congress for the purpose of introducing new legislation in this field. Details will be found in our report of a talk on "1959 Legislative Outlook," which was part of the annual meeting of The Rubber Manufacturers Association, Inc.

INDUSTRY NEWS

Industry Performance, Business and Legislative Outlook RMA Meeting Theme

About 200 rubber company executives were present at the forty-third annual meeting of The Rubber Manufacturers Association, Inc., held in the Park Lane Hotel, New York, N. Y., to hear speakers from their own organization and nationally known experts in the fields of economics and industrial and foreign relations describe the past, present and future outlook for business, with special reference to the rubber industry.

Ross R. Ormsby, RMA president, presided at the morning and luncheon sessions. At the morning session he explained, first, how the RMA had served the industry during the past year of recession and recovery and then introduced the speakers at this session. Following Mr. Ormsby, Karl O. Nygaard, director, business research department, B. F. Goodrich Co., spoke on "Rubber Industry Performance in a Year of Recession and Recovery." W. J. Sears, RMA vice president, discussed next "The 1959 Legislative Outlook." The final speaker during the morning session was Jules Backman, professor of economics, New York University, and an outstanding economist, author, and educator, who explained in his own inestimable manner "The Economic Environment and Collective Bargaining in 1959."

At the luncheon, RMA board members and officers, morning session speakers, and the luncheon speaker were introduced by Mr. Ormsby. He also introduced guests of the RMA: Sydney L. W. Mellen, chief, Commodities Division, United States Department of State; S. E. Overley, chief, rubber branch, Chemical & Rubber Division, Business Defense Services Administration, United States Department of Commerce; Greig B. Smith, manager and secretary, Rubber Association of Canada; and W. S. Richardson, director, B. F. Goodrich Co.

The accompanying photograph of a portion of the head table at luncheon shows Mr. Ormsby and some of the industry executives serving on the RMA board of directors.

After luncheon, John A. Stephens, vice president, U. S. Steel Corp., who served as deputy chief of the American Steel and Iron Ore Mining Industries delegation to the Soviet Union in May and June of this year described his "Impressions of the Soviet Union."

RMA Board Elections

RMA members elected two new directors and reelected four for three-year terms at this meeting. The new directors are Fred B. Williamson, III, president of the Goodall Rubber Co., and Russell DeYoung, president of the Goodyear Tire & Rubber Co.

Those reelected were A. L. Freedlander, chairman, Dayton Rubber Co.; T. W. Miller, Jr., president, Faultless Rubber Co.; William O'Neil, president, General Tire and Rubber Co.; and J. W. Keener, Goodrich president.

"RMA Serving Industry"

Development of tools to aid industry in cost cutting and improving customer relations took on new importance as service functions of the RMA during the 1957-58 business decline, Mr. Ormsby said in his talk "RMA Serving Industry."

Major progress was achieved by the Traffic Committee, for example in negotiating a 7% reduction in freight rates from the Southwest, a 15% reduction from eastern railroads on rates covering a wide range of rubber end-products, and a reduction of $3.50 a ton on shipments of crude natural rubber from the Far East.

In organizing and operating the new Rubber Shippers Association, the Traffic Committee made it possible for scores or companies to cut transportation costs further by consolidating less-than-car or less-than-truck lots and take advantage of the lower carload rates by consolidating merchandise for carload shipments.

The industry's attention was directed to the Crude Rubber Committee's findings that more than 40% of the dry natural rubber imports by grade failed in 1957 to conform to the quality specified in the buyer's contract. All buyers were urged to check the quality of imports against standards established in type sample books issued under this committee's direction to insure that they get the quality paid for.

In the field of customer relations, Mr. Ormsby cited the Tire Division's distribution of more than three million illustrated folders on tire care and safety, and its broad distribution to dealers of manuals covering the service aspects of tubed and tubeless tires and bulletins on the common causes of retread failures. In this connection, he noted also the wide acceptance of the "Rubber Handbook—Specifications for Rubber Products," prepared for their customers by members of the Molded, Extruded, Lathe-Cut and Chemically Blown Sponge Rubber Products Division.

Referring to one of the Association's basic functions, the tremendous increase in the volume of statistical information that is compiled for industry was described. Reviewed, also, were the extensive activities of the Manufacturing Committee in the field of industrial relations, and the reactivation of the association's Public Relations Committee.

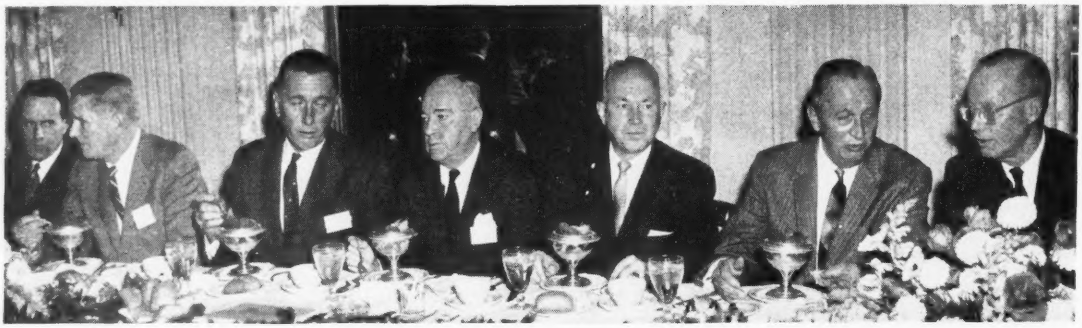
The success of these and other committee and divisional activities was credited by Mr. Ormsby in a large degree to the active participation of more than 600 industry executives in the day-to-day work of the RMA's 59 standing committees. He said it is clear that the problems confronting the industry in 1959 in the varied fields of legislation, increased imports, collective bargaining, and government regulation, as well as further efforts to keep costs down, emphasize the importance of full industry participation in the work of the Association's committees.

Rubber Industry Performance in 1958

Mr. Nygaard explained first that his review of rubber industry performance during 1958 and of the current demand-supply outlook in natural and synthetic rubber, aside from certain government data, was based on information developed by the RMA Statistical Committee and staff, and that it was his privilege to represent the committee before the meeting.

Industry new rubber consumption at about 1,330,000 long tons in 1958 will be 9% less than in 1957, but 1959 consumption was estimated at about 1.5 million tons, almost 13% more than will be consumed this year.

No single figure or simple statistical comparison could possibly convey a true impression of the rubber industry performance during the past year, with its zig-zag of sharp declines in sales and production, followed by rapid recovery, and with its tremendous variations in market conditions product line by product line, Mr. Nygaard said. The recent recession in the rubber industry



A part of the head table at the RMA forty-third annual meeting luncheon *(left to right)*: R. C. Firestone, president, Firestone Tire and Rubber Co.; Thomas Robins, Jr., chairman, Hewitt-Robins, Inc.; J. W. Keener, president, B. F. Goodrich Co.; John A. Stephens, vice president, U. S. Steel Corp. and luncheon speaker; Mr. Ormsby; L. R. Jackson, vice chairman, Firestone; and H. E. Humphreys, Jr., chairman, U. S. Rubber Co.

began in August, 1957, about the same time as the start of the decline in total industrial production. In the eight months following, the monthly production rate in rubber goods manufacturing, as measured by the Federal Reserve index for the industry, was reduced 21%; only the automotive, electrical machinery, and primary metals industries fared worse, he added.

RECESSION AND RECOVERY. If you are going to be able to act quickly in situations of rapid change, you need reliable, up-to-date information on industry activity. In retrospect, it seems that at the critical turning point in August, 1957, and even some months later, the available factual information concerning rubber industry activity provided little advance warning that a recession was in the offing—certainly not a decline of the magnitude that actually took place.

Although this may be partly a matter of inadequate interpretation of the available data, there is more to the problem, it was said, and the data shown in Table 1 were presented to illustrate the point. There was no sign of weakness in rubber consumption until December, 1957; shipments of replacement passenger-car tire shipments were unusually strong through October, 1957; demand for original-equipment tires was fairly strong through the end of 1957; and hose and belting sales did not decline until November.

The reasons why our major business indicators provided little advance warning were due mainly to (1) the nature of the recession itself, and (2) shortcomings in available statistical information, Mr. Nygaard explained.

The general business recession did not get its start in the automotive industry and was not characterized by any significant weakness in consumer income or personal consumption expenditures. The recession in the rubber industry may be traced to the decline in business capital outlays and to the switch from general business inventory accumulation to substantial inventory liquidation, he added.

Industrial rubber products are widely used throughout American industry, and the trend in new orders and sales for these products could be a most useful indicator of changes in general business conditions. Factual industry information concerning production, sales, and inventories of industrial rubber products is far from complete, however, and on a monthly basis, nonexistent. The RMA Statistical Committee recommended that further research be undertaken to broaden the scope and improve the reliability of industry statistical information in this important product field.

In April this year, the shift from business contraction to business expansion got under way. There were two recovery points for the rubber industry this year; the first was when the downslide in industrial rubber business was halted, and the second was with the beginning of full-scale production of the 1959 automobile and truck models. Now with the automotive industry returning to full production schedules, recovery in all major segments of the rubber industry is under way, it was said.

In connection with rubber industry performance from the standpoint of industry employes and stockholders, the size of the rubber industry labor force was maintained through the end of 1957, with reduction of production and non-production employes from January through May, 1958, amounting to 37,000 workers. With the upswing in business, through September of this year, 16,000 production workers have been recalled, and the work week lengthened.

Despite lower production volume and reduced employment opportunities this year, average hourly earnings for rubber production workers in September '58 reached $2.38, excluding the various supplemental employment benefits, which amounted to 9¢ an hour, or 4% higher than in September, 1957. Only three industries—primary metals, ordnance, and chemicals—show larger increases in hourly earnings than the rubber industry during this period.

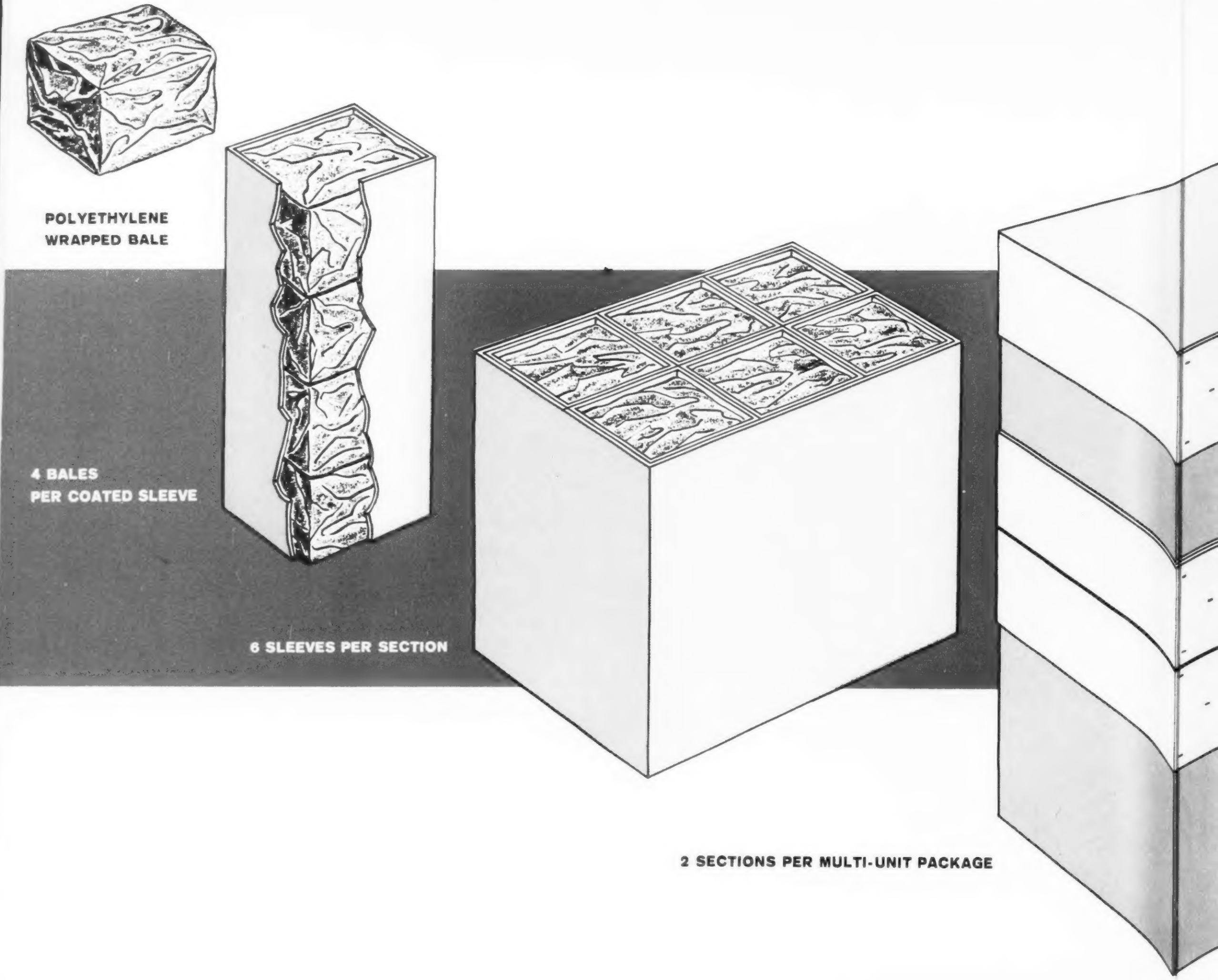
According to Federal Trade Commission and Securities & Exchange Commission data, rubber industry profits after taxes in the first six months of 1958 were 29% below the total in the last half of 1957. The dollar sales decline for this same period was 9%. Profit margins in the rubber industry, whether measured as a percentage of sales or return on capital, at 3.2% and 5.7%, respectively, are below the averages for all manufacturing industries of 3.6% and 6.1%, for the first half of 1958. The financial results for the third quarter of 1958 released by a number of companies indicate, however, that industry sales and profits have improved substantially as compared with those for the first half of the year.

RUBBER SUPPLY AND DEMAND. During the past several weeks the RMA has reexamined and brought up to date the significant information on trends in rubber supply and consumption. Table 2 shows the estimated world production capacity of natural and synthetic rubber through 1962, with synthetic rubber capacity in Soviet bloc countries not included. The significant points illustrated by these figures were summarized as follows:

1. Rubber producers have announced planned expansions which will raise natural and synthetic rubber capacity from 1957's 3.4 million long tons to an estimated 4.4 million long tons by 1962, or an increase of almost 30% within five years.

2. Synthetic rubber will account for virtually all of the increase in world new rubber supplies over the next several years. The work of governments and of private producers in Malaya, Liberia, and certain other nations in building a sound future for natural rubber is to be commended. Nevertheless, because of the declining trend of production in Indonesia, the world supply of natural rubber will not increase appreciably in the years ahead.

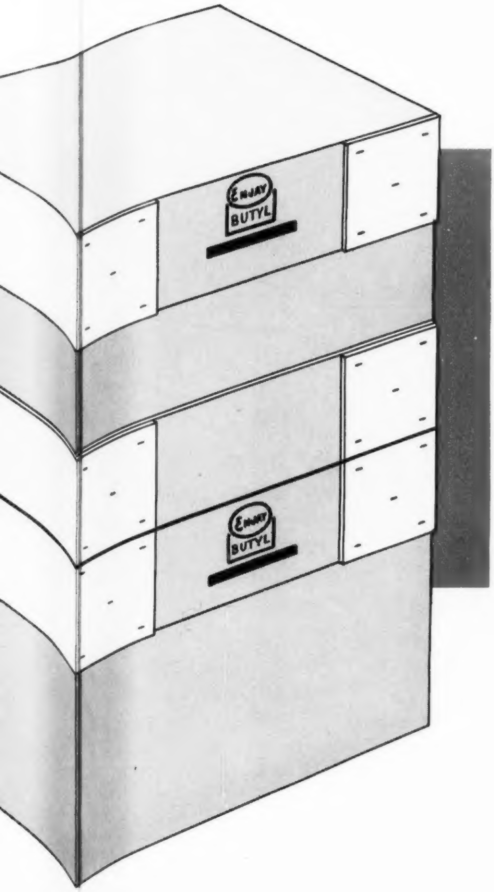
3. Synthetic rubber capacity in the



EACH SECTION CONTAINS SIX CORRUGATED SLEEVES each holding four bales of polyethylene-wrapped Butyl. Thus, you get a total of 48 bales of Butyl in a complete Multi-Unit Package.

YOU NOW CAN UNLOAD FASTER in the close quarters of trucks or freight cars due to package size, shape and construction. New Multi-Unit Packages can be conveniently handled by low-cost palletless methods.

BECAUSE OF THE MULTI-UNIT your storage and shipping space ca lized. The two separate 36" sections practically any available storage spa



THE NEW MULTI-UNIT PACKAGE

- Reduces unloading costs
- Allows efficient use of storage space
- Affords handling economies
- Protects product until used.

THE NEW MULTI-UNIT BUTYL PACKAGE weighs approximately 2,800 pounds and may be conveniently divided into two separate sections, each weighing about 1,400 pounds. The over-all package measures 32″ x 48″ x 72″. Each of the two separate sections is 36″ high.

THE MULTI-UNIT PACKAGE,
l shipping space can be fully uti-
parate 36″ sections permit use of
vailable storage space.

MOVEMENT WITHIN YOUR WAREHOUSE IS EASIER. The extra-strong, extra-light reinforced package supplies protection against knocks, bumps and in-transit sliding.

THE UPPER AND LOWER SECTIONS CAN BE SEPARATED by inserting the fork of the fork lift truck between the two sections. This versatility of the package permits the storing or handling of Butyl in either 2,800 or 1,400 pound units without removing it from a closed and sealed package.

TABLE 1. MAJOR BUSINESS INDICATORS FOR THE USA RUBBER INDUSTRY

(Monthly Trends, Calendar Year 1957)

	USA New Rubber Consumption (000 Long Tons)	Industry Tire Shipments—(Millions of Tires): Replacement: Passenger (Seasonally Adjusted-Annual Rate)	Replacement: Civilian Truck-Bus (Seasonally Adjusted-Annual Rate)	Original-Equipment Passenger	Indices of Hose and Belting New Orders and Sales (January, 1957=100): New Orders	Sales
Jan.	137.7	57.2	7.5	3.2	100.0	100.0
Feb.	123.3	66.5	7.8	3.0	87.0	104.7
Mar.	129.5	59.1	9.1	3.1	90.5	113.3
Apr.	121.4	56.1	9.7	2.8	98.1	101.6
May	126.4	52.7	7.7	2.8	90.5	109.4
June	111.4	51.2	7.6	2.6	80.5	97.0
July	108.5	56.3	8.3	2.7	89.3	95.5
Aug.	123.8	56.8	7.8	2.9	98.8	102.0
Sept.	120.9	62.0	9.1	1.4	79.2	99.5
Oct.	137.2	61.4	9.3	2.3	82.1	106.2
Nov.	118.8	54.7	7.3	3.1	68.6	79.5
Dec.	105.6	50.4	7.4	2.8	68.4	88.8
Annual total	1,464.6	56.6	8.2	32.7		

Source: All data, RMA.

free world outside the United States is growing rapidly. This year, an estimated 225,000 tons of synthetic rubber will be produced in free nations outside of the United States. By 1962, production capacity in these nations will have almost tripled.

Table 3 compares estimated new rubber capacity with consumption requirements for the same 1957-1962 period. The long-term growth trend in world new rubber consumption is about 4% per year, with consumption in the United States rising on the average by around 3% per year, and the rest of the Free World by 6% per year. In 1958, total capacity exceeds total demand by roughly 650,000 long tons and a margin of this magnitude will probably be maintained at least through 1962.

New rubber consumption in the Free World outside the United States will be 100,000 tons greater than the USA total in 1958 and will at least match and more likely run ahead of the amount of new rubber used in this country in the future.

Natural rubber imports into the Soviet bloc countries are estimated at about 350,000 long tons this year, 20% more than the 1957 total.

Other nations of the Free World will consume an estimated 375,000 tons of synthetic rubber this year, equivalent to 25% of their total new rubber requirements. Last year the percentage of synthetic rubber used was 23.8% and in 1956 it was 20%.

In concluding, Mr. Nygaard said that if the present is the prologue to the future, the rubber industry accepts the challenge of rapid market expansion in 1959 and the opportunity to outperform the general business trend.

"1959 Legislative Outlook"

Mr. Sears in his talk on "The 1959 Legislative Outlook" pointed to labor's sweeping gains in the November elections and told management that it must accept the challenge to organize and utilize its political resources if it is to preserve an economic climate that will permit growth and progress. He pointed out that national business organizations have been exhorting business to step up its responsibilities in political leadership, and if rubber manufacturers, as an important and essential segment of the economy share this sense of urgency, they too should accept the challenge.

Mr. Sears recited the claim of the AFL-CIO Committee on Political Education that it had seated 70% of its endorsed candidates overall. In the new Congressional lineup, 54 of the 98 Senate members and 220 of the 436 House members will carry AFL-CIO endorsement.

Four areas of Congressional activity of most consequence to the business community, that is, taxation, federal spending, labor laws, and business regulation, were reviewed.

TAXATION AND SPENDING. No changes of any significance are anticipated with respect to federal taxes, but, with a budget deficit of $12 billion in prospect for the fiscal year ending June 30, 1959, tax reform in 1959 is a very good bet, it was said. Both tax reduction and tax increase bills will be introduced, but any change in the non-election year of 1959 is unlikely insofar as personal and corporate income taxes are concerned. Highway-user excise-tax increases to offset the looming deficit in the Highway Trust Fund may be urged, however.

Since there are not too many economy-minded Representatives and Senators left in the newly elected Congress, federal spending, particularly for non-military domestic programs is slated to increase. During the 85th Congress just concluded, and contrary to most public opinion, the large increase in spending was in non-defense programs — compared to 1955 figures, these are up 53%, while defense programs are up only 12%, Mr. Sears said.

LABOR LAW. A new weak labor bill, somewhat similar to the Kennedy-Ives bill, which was defeated in the House during the last session, is expected to be approved in 1959. The leaders of both House and Senate have already indicated that a labor bill will be part of their program for the next year. In addition to attempts at major revision of the Taft-Hartley Act, and last year's pension and welfare protection bill, efforts will be made to extend the coverage of the Fair Labor Standards Act and increase the minimum wage.

BUSINESS REGULATION. In the field of business regulation, the tire industry can expect the introduction of a bill which would provide that tires for replacement purposes could be sold

TABLE 2. ESTIMATED WORLD NEW RUBBER PRODUCTION CAPACITY, 1957-1962

(Thousands of Long Tons)

	1957	1958	1959	1960	1961	1962
Natural rubber production	1,903	1,885	1,925	1,950	1,975	2,000
USA synthetic rubber capacity	1,372	1,665	1,686	1,686	1,715	1,734
Rest of the Free World synthetic rubber capacity	150	225	335	490	615	630

Source: RMA and Secretariat, IRSG.

TABLE 3. ESTIMATED WORLD NEW RUBBER PRODUCTION CAPACITY AND CONSUMPTION 1957-1962

(Thousands of Long Tons)

	1957	1958	1959	1960	1961	1962
Natural rubber production	1,903	1,885	1,925	1,950	1,975	2,000
New rubber consumption	3,145	3,130	3,350	3,515	3,650	3,780
Production capacity	3,425	3,775	3,946	4,126	4,305	4,364

Source: RMA and Secretariat, IRSG.

only by independent tire dealers. Another and perhaps more successful effort will be made to nullify the "good-faith" defense to charges of price discrimination brought under the Robinson-Patman Act. This proposal, identified as S. 11 in the Senate of the last Congress, was allowed to die in the rush of adjournment.

Another proposal that will be pressed by the left-of-center liberals is known as the Mandatory Functional Discount Bill, said Mr. Sears. Passage of this bill would mean that manufacturers would be required by law to sell their products at a lower price to customers classified as wholesalers than to those classified as retailers. Another bill in this category is known as "The Price and Discount Notification Bill," which would require manufacturers to notify each and every one of his customers of the prices and discounts offered to any single customer.

It is likely that in this next Congress the Pre-Merger Notification Bill will have a better chance of approval. This bill calls for notification to the government of mergers at least 60 days before they take place.

Then there are to be reckoned with the efforts of the Senate Anti-Trust & Monopoly Subcommittee to develop an appropriate public policy to deal with the problem of administered prices in highly concentrated industries and the announced intention of Senator O'Mahoney of this subcommittee to introduce legislation that would require large corporations dominant in their fields to justify proposed price increases to both the executive and legislative branches of government before the higher prices become effective.

These legislative pitfalls in the field of business regulation do not present an encouraging picture, it was said. Most Washington observers believe that business will be in for far more harassment than ever before and with fewer friends in Congress to help it. Nevertheless, it is not expected that there will be sweeping radical changes as a net result of this punitive activity.

MANAGEMENT AND THE BUSINESS CLIMATE. In concluding, Mr. Sears emphasized that today management must realize that there are many outside conditions that affect the cost and ease of operating a business. These outside conditions may be social, economic, or political, and their net result has been described as the Business Climate.

If industry is to influence constructively the Business Climate, management must be prepared to accept political responsibility and leadership. Some companies have accepted this challenge of discovering and organizing the political resources of business. National business organizations are urging more companies to join this movement. One of these identifies its program under the title of "Public Affairs—Key to Business Survival."

Karl O. Nygaard

If rubber manufacturers share this sense of urgency, they, too, should accept this challenge, and on this note the RMA vice president ended his talk.

Economic Environment and Collective Bargaining

Dr. Backman, in his talk entitled, "The Economic Environment and Collective Bargaining in 1959," explained that in recent years an enormous amount of economic data have been used in connection with collective bargaining. To make these data meaningful a framework of reference is indispensable, and this framework has been provided by the use of six wage criteria: namely, economic environment, cost of living, workers' budgets, wage comparisons, productivity, and ability to pay. He then proceeded to examine the probable outlook under each of these wage criteria.

ECONOMIC ENVIRONMENT. In connection with economic environment it was pointed out that the gross national product reached a peak annual rate of $445.6 billion in the third quarter of 1957 and then declined abruptly to $425.8 billion in the first quarter of 1958. By the 1958 third quarter, the total was about $440 billion, and there has been a continuation of the upturn in the fourth quarter. An all-time high GNP was predicted by the end of the year.

The major part of the decline in GNP was accounted for by a swing in inventories from a $2.2 billion annual rate of accumulation to a liquidation rate of $9.5 billion in the 1958 first quarter. This shift in inventory policy accounted for almost $12 billion out of the total drop of about $20 billion in GNP. The annual rate of inventory liquidation was cut to $8.0 billion in the 1958 second quarter to $4.0 billion in the third quarter. The reduction in inventory liquidation has been an important contributing factor in the recovery which has developed since last spring. Seasonally adjusted rubber inventories reached a peak of $1,101 million in November, 1957, and then declined to $980 million in July, 1958. They rose to $1,024 million in August.

A second important factor contributing to the recession was the cutback in plant and equipment expenditures from a peak annual level of $37.8 billion in the 1957 third quarter to $32.4 billion in the 1958 first quarter and an estimated $30.3 billion in the third quarter. A slight increase is expected in the fourth quarter. Recovery in the national economy has developed despite the continuing decline in these expenditures.

The reductions in inventories and in new plant and equipment expenditures were primarily responsible for the behavior of the Federal Reserve Board index of industrial production which fell from a peak of 146 in February, 1957, to 126 in April, 1958, and then recovered to 138 in October. The index of production of rubber products was 145 in January and February, 1957. It reached a low point of 112 in April, 1958, and recovered to 135 in September.

Employment in October was about 700,000 below the peak levels of a year earlier. Total unemployment at 3.8 million, however, while moderately below the spring peak, is still 1.3 million higher than for last year. Dr. Backman emphasized that the difference of 600,000 between the rise in unemployment and the decline in employment reflected the increase in the size of the labor force. The combination of rising productivity and the increase in the size of the labor force accounts for the lag in declines in unemployment. In October, 1958, employment of production workers in the rubber industry was estimated at 192,100, or 8.4% lower than the total of 209,800 a year earlier. For all manufacturing industries employment of production workers was 8.7% lower in October than a year earlier.

Despite the recession, consumer incomes were well maintained, and as a result, total consumer spending recorded only small changes. Thus, disposable income fell from $308.7 billion to $305.0 billion, or slightly more than 1%, and as a result, personal consumption expenditures declined from $288.3 billion to $286.2 billion, or slightly less than 1%. Disposal income has already risen to a new record level of $314 billion in the third quarter, and the upward trend is continuing.

Wholesale and retail prices are now moderately higher than in September, 1957. The consumer price index is 2.1% higher, but has recorded little change since March. The wholesale price index has risen less than 1% as a result of higher food prices. Industrial prices have recorded little change since the Summer of 1957 despite the increases in some prices, such as steel and aluminum. The

wholesale price index for rubber products was 147.9 in December 1956; it declined to 143.8 in May, 1958, and has since risen to 144.8.

Despite the recession, average hourly earnings continued to rise. For all manufacturing industries the average was $2.14 per hour in September, 1958, as compared with $2.08 a year earlier. For all rubber products, average hourly earnings increased from $2.29 to $2.38; for tires and tubes, the average increased from $2.66 to $2.81 in August.

In examining the factors which will influence the future trends of business, Dr. Backman divided these into expanding, neutral, and negative factors.

Expanding Forces. Because of larger expenditures for defense and other programs, it is expected that federal spending will contribute an additional $3.5 billion to the GNP in 1959. Greater spending accompanied by lower tax revenues will mean a budgetary deficit of an estimated $12.2 billion. State and local government spending for education, highways, hospitals, etc. has been rising at an annual rate of about $2.5 billion in recent years. Thus federal, state, and local spending combined should add about $6.0 billion to the total national economic activity.

Consumer disposable income is now at a new record level, and further increases are probable. Labor income has already started to rise and under the impact of higher wage rates, longer work weeks, and greater employment should increase to new record levels in 1959. This rise will be offset in part by a reduction in unemployment insurance payments. Dr. Backman said he anticipated only minor net changes in other types of consumer income including dividends, interest, and rental income. The U. S. Department of Agriculture estimated recently that net farm income will fall some 5-10%. The total rise in consumer incomes will increase total consumer spending, however, to new record levels, it was said.

The automobile industry should share in the greater volume of consumer spending since the business recovery means more and better jobs which will lead to an expanding demand for automobiles. Currently auto purchases account for only 3% of consumer income, as compared with a normal rate of above 4%. Auto sales should rise above the five-million mark, and sales of tires and tubes for original equipment as well as sales of other rubber products should benefit accordingly.

Inventory liquidation should shift to inventory accumulation by the Spring of 1959, if not earlier, and this shift can give the economy a stimulus of $6 billion or more. Contract awards, which portend future spending for building, have risen to record levels. While there are still some lagging areas, such as manufacturing plants, these are more than offset by sharp expansion in contracts for highways and other heavy engineering projects,

W. J. Sears

schools, and electric power and light construction.

Neutral Forces. Plant and equipment spending surveys suggest that the decline in these areas has ended, and a modest rise in such spending is now being projected for 1959.

New orders have finally risen to the level of current deliveries after being below them since Nobember, 1956. From that month until May, 1958, American industry lived in part on its unfilled orders which were reduced from $63.4 billion to $46.1 billion. Since May, new orders have been in line with deliveries so that the unfilled-order backlog has remained about $46 billion.

Negative Factors. Residential housing has expanded sharply since early this year. The combination of government loans, easier credit terms, and greater availability of credit contributed to this sharp rise in the number of housing starts, but the impact of these forces is now behind us, it was said. Interest rates have begun to rise again, and the billion dollars available to buy mortgages has been fully committed by the Federal National Mortgage Association. In addition, the government's need of funds to finance the budget deficit will act to reduce the supply of funds available for mortgages. It is likely that when the full impact of these factors is felt, housing starts will decline below the current level; hence housing will become one of the negative factors.

The main negative factor in the economic picture today is the tightening of money and credit with the accompanying rise in interest rates. The Federal Reserve Board signaled a reversal of its very easy money policy by increasing stock margin requirements and by approving a rise in the discount rate in August. Long-term interest rates have risen back to the levels of the Fall of 1957, and this rise has led to some reconsideration of new financing. It could cut off some demand for new housing and could curb some potential buyers of consumers' durable goods.

Outlook. A balancing of the forces discussed suggests that business recovery will continue into 1959, Dr. Backman said. Many companies will be conducting their labor negotiations against a background of rising sales and the optimism which such a situation generates.

COST OF LIVING. In many of the postwar years an increase in the consumer price index has been a major factor in wage negotiations, and today there is a widespread fear of inflation, but Dr. Backman does not feel that rising prices will play a significant role in 1959 labor negotiations. He is convinced that the fears of inflation are being considerably exaggerated insofar as they apply to the early future, for the following reasons:

1. Up to this point, sensitive prices which are most responsive to inflationary pressures have recorded only minor changes, and the same is true for wholesale prices.

2. Our money supply has been increasing at less than the 3% long-term rate of gain and the FRB probably will act to contain any new major gain in money supply.

3. The federal budgetary deficit is a serious force for inflation, but economic recovery will mean higher tax revenues and, in turn, a smaller deficit. Similarly, recovery will reduce payments for unemployment insurance and increase the taxes collected. Thus, the cash deficit will fall faster than the deficit in the administrative budget, and inflationary pressures from this source will be reduced accordingly.

4. Record farm corps will act as a barrier to inflationary price rises for foods.

5. Wage inflation should be smaller than in the past three years because labor costs will rise more slowly and output per manhour will increase more rapidly—at least during the first year of recovery.

6. We no longer have large backlogs of deferred demand which create urgent pressure on prices.

Because of these factors, Dr. Backman expects that the current inflationary fever will subside, and that the consumer price index will not record a major advance in the next year.

PRODUCTIVITY. Increase in output per manhour lagged behind long-term rates of gain in 1956 and 1957. For the entire private non-farm economy the inrease was 0.2% in 1956 and 1.2% in 1957, as compared with the long-term annual rate of gain of about 2.0%. For manufacturing industries the rise was 0.4% in 1956 and 0.8% in 1957, as compared with the long-term rate of increase of 3%.

Year-to-year changes in output per manhour are influenced by changes in volume. During a period of recovery, output tends to rise more rapidly than

manhours as the employed labor force is utilized more fully and more efficiently than is possible when volume is low. If his forecast concerning business recovery is correct, Dr. Backman said, then we can expect that an accompanying development will be a rise in output per manhour closer to the rates indicated by the long-term experience than was witnessed in the past three years.

It was emphasized, however, that recent and past increases in labor costs have exceeded gains in output per manhour by wide margins, and thus rising output per manhour will not justify still larger increases in labor costs. On the contrary, to limit wage inflation the increases in labor costs must be smaller than in the past few years.

COMPARATIVE WAGES. During the war and postwar period, wage comparisons have been a significant factor in the settlements for large companies and leading industries. In this connection the recent settlements in the automobile industry will be important in 1959 wage negotiations.

The cost of the Ford Motor Co. settlement was estimated at 9¢ an hour for wages plus 2¢ or 3¢ for fringe benefits plus or minus cost of living adjustments. Other settlements already agreed upon for 1959 include: General Electric, 3.46% with 5¢ minimum; Central States Trucking, 7¢, Lockheed Aircraft (and other aircraft companies), 3% with a 7¢ minimum.

As a result of these settlements, the wage target for many unions will be a wage package of 7¢ or 10¢ an hour plus some non-wage benefits, Dr. Backman declared.

ABILITY TO PAY. The 1957-58 Recession dropped corporate profits before taxes from an annual rate of $44.2 billion in the 1957 third quarter to $31.7 billion in the 1958 first quarter, a drop of 28.3%. A slight rise in profits took place in the second 1958 quarter, and rising business activity brought about a further recovery of profits in the last two 1958 quarters. The speaker questioned whether business recovery will have advanced to the point required to permit profits to return to 1955-57 levels by early 1959.

Dr. Backman does not consider ability to pay to be a significant determinant of proper wage adjustments although a good profits environment usually induces management to lean to a more liberal reading of the significance of the other criteria.

CONCLUSION. It was concluded that the economic environment for wage negotiations in 1959 should differ from that in 1958 in several respects: business will be recovering instead of receding; profits will be rising instead of falling; and output per manhour will be increasing somewhat more rapidly. The economic environment should be similar in regard to prices and wage patterns although it is possible that the consumer price index will show only unimportant changes. Rising output per manhour combined with somewhat smaller increases in total labor costs would make it possible to limit wage inflation for the first time in several years. If that goal can be achieved, it will be most helpful to all groups in the economy including the workers themselves, Dr. Backman pointed out.

Jules Backman

Carbon Black Plant For France

Phillips Petroleum Co., Bartlesville, Okla., and Continental Carbon Co., New York, N. Y., have formed a jointly owned French Company to build and operate an oil black plant in France. Engineering and design work on the 56-million-pound annual-capacity plant is nearing completion although the site has not yet been finally decided. The plant will use the basic Phillips process pioneered and used by Phillips as well as used by Continental.

The joint announcement made by K. S. Adams, chairman of Phillips, and R. I. Wishnick, president of Continental, stated that high-quality blacks would be produced and would be marketed by Phillips and by Witco Chemical Co. under their usual trade marks. A modern laboratory for quality control and customer service will be part of the new facility.

First Turnover Belt System for Coal Haul

First turnover conveyor belt system ever used for long-distance hauling of coal is now delivering 800 tons an hour to barges on the Green River near Drakesboro, Ky. Coal flows from Pittsburgh-Midway Mining Co.'s Paradise Mine preparation, located more than a mile from the river. Developed by B. F. Goodrich Industrial Products Co., Akron, O., the turnover principle enables the belt to turn itself over after delivering a load, and again, before accepting a new load.

Turned 180-degrees at each end of the system, the belt's thick carrying cover is always positioned to receive the load, but only the clean side of the belt is permitted to run on top of the return idlers. This practice prevents clogging and damaging buildup of tacky materials on idlers or pulleys and eliminates need of deck plates to protect the return run of the belt from spillage.

The turnover belt action is accomplished by placing two twist pulleys at each end of the system. It is possible to convert any conventional belt conveyor system into the turnover type. The system is recommended where sticky or corrosive materials must be handled.

Longest belt of the Paradise Mine conveyor system is a 36-inch wide, four-ply belt that spans 4,400 feet in one continuous flight. It travels 600 feet a minute. The remaining belt measures 2,550 feet, conveys 800 tons an hour of minus-two-inch coal. Both belts in the overland system have the same specifications. This overland conveyor replaces a system of truck transport in use for six years. The new belt system is reported to be showing a two-thirds savings in production time through increased barge-loading efficiency.

Other Goodrich conveyor belts at Paradise Mines include a 42-inch wide belt, 675 feet long, which links the preparation plant with a rail-mounted stacker at the stockpile. This belt moves 930 tons an hour, traveling 525 feet a minute. The stacker belt, of similar construction, conveys coal up a 19-degree slope to the stockpile. A 42-inch wide, five-ply reclaim belt tunnels 700 feet to convey stockpile coal to the overland system.

Compressor for Use With Nuclear Reactor

Allis-Chalmers Mfg. Co., Milwaukee, Wis., is supplying its new barrel-type, single-stage centrifugal compressor for use with a nuclear gas cooled reactor at the National Reactor Testing Station (Idaho) plant of the U. S. Atomic Energy Commission. This is the first application of this type compressor in this service. The project which is being conducted by the Aerojet General Corporation, a division of the General Tire and Rubber Company, as architect-engineer contractor is identified as the Gas Cooled Reactor Experiment. Similar to the barrel-type multi-stage compressor used in the petroleum industry this single-stage model was developed last year by Allis-Chalmers.

Karl J. Nelson

John E. Wood, III

A. Donald Green

Harold J. Rose

Fifteenth Anniversary For Polymer Corp.

September 29, 1958, was a milestone in the history of Polymer Corp., Ltd., Sarnia, Ont., Canada. The day marked the fifteenth anniversary of the first commercial production of synthetic rubber in Canada. The plant was built as a war emergency measure in 1942-43 with a designated capacity of 41,000 long tons per year at a cost of $48 million. Additions and improvements in the plant have increased capacity until today it stands at 130,000 long tons per year. The initial work force of 1,800 has grown to one of 2,800, with a corresponding payroll growth from $4 million to more than $14 million.

During the first two years production was funneled into the Canadian and United States war effort, but after hostilities ceased and sales programs were established, world wide markets were developed. Today 70% of the total production is sold in export to more than 60 countries.

Research and development programs have been successful in increasing the number and the type of polymers offered. The original four Polysar rubbers have been expanded to 23, which now include cold nitrile and butyl types. Some of the innovations claimed by Polymer Corp. are the cold nitriles, the first self-reinforced rubber, Polysar SS-250, and the introduction of butyl recipes for compounds to produce low temperature resistant inner tubes.

Enjay Elects Officers

Enjay Co., Inc., New York, N. Y., has announced the election of a new president and three new vice presidents. John E. Wood, III, general manager of the chemical products department of Esso Standard Oil Co., becomes president of Enjay, effective immediately. He replaces O. V. Tracy in this position. Mr. Tracy, who has had dual responsibility as Enjay president along with being vice president and director of Esso, will now devote full time to his duties as contact director for all Esso's manufacturing activities. A. Bruce Boehm will continue as executive vice president and director of Enjay, a post he has filled for the past two years.

The new vice presidents are Karl J. Nelson, Harold J. Rose, and A. Donald Green. Mr. Nelson will continue to direct the sales department which he has headed since July. His department includes two domestic sales divisions operating through nine sales offices, an export sales division, customer service and customer relations, and the recruiting and training of sales personnel.

Mr. Rose, who has been directing the products management department since August, will also continue in this assignment. The products management department includes three divisions, butyl rubber, Paramins, and chemicals, and the Enjay laboratories in Linden, N. J. Mr. Green, new projects department manager, will direct the company's new project development, market analysis, and market development.

Xylos' Rub-R-Road

The Xylos Rubber Co., Akron, O., a subsidiary of The Firestone Tire & Rubber Co., has developed and successfully tested a new method for mixing rubber into asphalt for resurfacing highways. The new method is described as the easiest way of blending the materials for resurfacing with rubberized asphalt that has ever been devised.

A liquid, called Rub-R-Road Compound R-524, is poured into a truckload of hot asphalt and may be blended right on the job. The rubberized asphalt is then sprayed from the truck on to the pavement.

Most other systems necessitate the premixing of rubber and asphalt before it is loaded into the tank truck. The Xylos compound is a ready-to-blend liquid, not in pellet or powder form, and does not require the boiling off of water.

All the compound needed to rubberize the asphalt required for the surface treatment of one mile of 24-foot-wide highway can be carried in three 55-gallon drums.

The addition of rubber to asphalt imparts a greatly increased toughness to the asphalt which is required to bind the stone to the surface, the company reports. The rubber increases the surface treatment's resistance to weathering. It also retards the asphalt's bleeding through the stone in the summertime and keeps the asphalt flexible at low temperatures, decreasing the tendency to crack in the wintertime.

Timken Bearing Plant For European Market

A modern plant for the manufacture of tapered roller bearings will be built at Colmar, France, by The Timken Roller Bearing Co., Division Française. On November 1, a merger became effective among the Timken Roller Bearing Co., Division Française, the Société Anonyme Française Timken, and the Service Français du Roulement. The new plant will be operated by this combined wholly-owned subsidiary of Timken, along with the existing plant in Paris. Colmar is located in eastern France near the point where the boundaries of Germany, France, and Switzerland meet.

Société Anonyme Française Timken was formed in 1928 and became a wholly-owned subsidiary of The Timken Roller Bearing Co., USA, in 1951. The company's Division Française will bring to France the engineering, production, and sales resources necessary to supply French customers with fine tapered roller bearings.

A full line of tapered roller bearings up to those with an outside diameter of 25 inches will be manufactured. Sizes will also include some in metric sizes. Capacity of the plant is expected to reach eight million bearings a year. The plant will be constructed in phases with production in the first phase of the building scheduled for Autumn of 1960. About 350 employes will be required.

Eastman Reports on 910 Adhesive Use

Although Eastman 910 Adhesive[1] was first announced to industry less than a year ago, Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Co., showed evidence at a press conference November 5 in New York, N. Y., that the new adhesive has evoked considerable interest and is being used to solve many problems in the bonding field. The company makes the claim that this is the first adhesive for producing high-strength bonds between many combinations of materials which does not require excessive pressure, heat, solvent-evaporation, or long curing time.

Along with showing typical uses and availability of the adhesive, Eastman Chemical announced that an agreement had been made with Armstrong Cork Co. to market the product through Armstrong Cork's industrial division along with the Eastman Chemical sales staff. In making this announcement, J. E. Magoffin, Eastman vice president, stated that the long experience of Armstrong Cork in the adhesives field and its organization capable of contacting the potential users of the product would aid the sales force of Eastman Chemical who call on customers not usually requiring adhesives.

Advantages and Limitations

Eastman 910 Adhesive is reported to be a methyl 2-cyanoacrylate monomer modified with a thickening agent and plasticizer. When the monomer is pressed into a thin film between two surfaces, a polymerization reaction occurs which results in a relatively rapid set. It was pointed out that the material does require proper handling. Particularly the quick-setting feature makes it essential that no attempt should be made to use the adhesive before reading the directions carefully.

The advantages may be summarized as follows: (1) one-component system, (2) no extensive surface preparation necessary, (3) easy to apply to small surfaces, (4) good coverage—only necessary to apply adhesive to one surface, (5) room-temperature curing, (6) only contact or slight manual pressure necessary, (7) very high-strength bonds, (8) very rapid setting, (9) very versatile—will bond almost all types of materials, (10) colorless bonds formed, (11) bonds have fair resistance to solvents, industrial fluids, low temperatures, and weathering.

The main limitation to widespread use of this adhesive is its cost. It is quite a bit higher than most adhesives on the market, so will be used mainly in those applications where it alone will do the job. It is also somewhat limited in applications subject to either high temperature or very high humidity.

[1]RUBBER WORLD, Nov., 1957, p. 296.

Water- and air-tight bond between plastic exhaust valve and rubber face mask for underwater swimming accomplished using Eastman 910 Adhesive by Pacific Moulded Products Co.

With the price schedule set at $75.00 per pound in one-pound polyethylene containers, a policy of not furnishing free samples had to be initiated. There is available, however, a testing kit containing a half-ounce sample bottle along with some glass slides and rubber stoppers which the company has for sale for trials and testing prior to use testing on the application desired.

Following the original announcement of the availability of Eastman 910 Adhesive on October 9, 1957, there were 1,297 inquiries received by November 11, 1957, just about a month later. Of these, to pick out a few, were 11 from automotive companies, 25 from the aviation industry, 38 from chemical plants, 28 on plastic products, and 32 concerning rubber usage. Among the many products using this new bond are skin diving masks, batteries, rubber rolls, and rubber stamps, and some of the material combinations bonded are: rubber-metal, metal-plastics-paper, plastic-metal, rubber-plastics, rubber-enamel, ceramic-rubber, rubber-rubber, and plastic-rubber-metal.

Some Applications

One of the interesting uses brought out at the meeting was the use made by Pacific Moulded Products Co., Los Angeles, Calif., who manufactures the "Wide View Mask" underwater face mask for a subsidiary division, Swimaster. An exclusive feature of this mask is a one-way purging valve which permits the diver instantly to clear the mask of accidental water leakage. This clearing is accomplished by a slight nasal exhalation through the valve.

Production of the mask presented a difficult assembly problem calling for a strong watertight bond between the plastic purging valve and the rubber body of the face plate. Eastman 910 Adhesive proved satisfactory out of the many adhesives tried despite the fact that it is not recommended for applications involving long or continuous underwater exposure.

Another unique use of the adhesive was made by a subsidiary of Eastman Kodak, Recordak Corp., New York, which utilized the product in a new microfilmer-endorser being put on the market. A feature of the machine which will both endorse and microfilm a check simultaneously is a rubber printing plate for endorsing, bonded to a steel support. Most of the adhesives tried would not stand up to the solvents in the inks. Eastman 910 Adhesive proved to be satisfactory, and field tests have shown the bond to be good for the life of the plate.

Assembly of the endorsing plate has been greatly simplified and can be carried out in the Recordak service centers around the country. Adhesive 910 is spread in a thin layer on the reverse side of the rubber plate which is then inserted into a metal clamping frame, adhesive side up. The steel back-up plate, to which a small amount of the adhesive has also been applied, is then placed on top of the rubber plate. Slight pressure is applied by means of a screw clamp for several minutes; then the assembly is ready to be delivered and installed in the microfilmer-endorser equipment.

A third-use history reported by Eastman Chemical was that employed by the Willard Storage Battery Division of The Electric Storage Battery Co., Cleveland, O. Willard desired to put a strap on the battery for convenience in carrying until the battery is installed. The attaching of the strap to the battery proved a vexing problem.

Trials were made with pressure-sensitive tapes, but it was found that the tape would have to extend around to the bottom of the case, requiring tipping of the battery on the assembly line. This was considered to be time consuming and costly. Rubber cements were also tried, but proved unsatisfactory in the amount of time required for curing. They were also not too satisfactory in low temperatures.

The problem was finally solved by use of Adhesive 910. On the production line the areas of the strap and of the battery are wiped clean with a solvent, and one drop of cement is applied to each end of the strap. The strap is then pressed into place.

Bonding is almost instantaneous, and within a few minues the bond will support up to five times the weight of the battery.

Adhesive Technology Breakthrough?

A. J. Slosser, manager industrial adhesives sales, industrial division, Armstrong Cork Co., backed up his company's sales agreement by stating that Armstrong considers the 910 Adhesive to be possibly a new breakthrough in industrial adhesive technology. He expects many cases to arise where this new adhesive will replace bolts, screw, or rivets, with great savings in time or greater flexibility in design where the combinations of materials or space limitations now prohibit assembly. Armstrong feels that this will be a valuable addition to the line of industrial adhesives now being marketed.

Fabian Bachrach

Frank K. Schoenfeld

Medal To Schoenfeld

Frank K. Schoenfeld, vice president-research, The B. F. Goodrich Co., Akron, O., has been named recipient of the Industrial Research Institute Medal for 1959. The Industrial Research Institute, organized in 1938 under the auspices of the National Research Council, has a membership of 158 companies with research staffs totaling more than 145,000 persons. Its broad objectives include the encouragement of improved industrial research management, the development of an understanding of research as a force in the life of the nation, and the promotion of high standards in the field of industrial research.

Announcement of the award was made at the Institute's fall meeting in Washington, D. C., by Frederick W. Stavely, president of the Institute and director of chemical and physical research laboratories, The Firestone Tire & Rubber Co., Akron, O. The medal has been awarded annually since 1945 to honor outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare.

The presentation of the medal to Dr. Schoenfeld will take place next May at the annual meeting of the Industrial Research Institute.

Dr. Schoenfeld, who joined BFG in 1927, has been vice president-research of the corporation since January, 1954. His early work as a research chemist on vinyl resins led to his appointment as manager of Koroseal research and development in 1939. When B. F. Goodrich Chemical Co., a division, was formed in 1943, Dr. Schoenfeld was appointed its technical superintendent, becoming technical vice president in 1946.

During World War II he was responsible for all technical operations of three synthetic rubber plants built and operated by Goodrich for the government. In his present capacity, he is responsible for all of the fundamental research effort of the Goodrich Company and for corporate new products development.

Alvin N. Gray

Alvin Gray Retires

Alvin N. Gray, winner of the 1957 James H. McGraw Award for Electrical Men, retired October 31 after more than 36 years in the Bell Telephone system. Mr. Gray has devoted his career to the problems of manufacturing insulated wire and cable, first with the Bell Telephone Laboratories and then with Western Electric. Until his retirement Mr. Gray headed the development engineering department at the Point Breeze works of the Western Electric Co., Baltimore, Md.

After graduating from the University of Virginia in 1922 he started his Bell career with the West St. (New York) engineering group. He transferred to the Bell laboratories in New York in 1925 and then to the Point Breeze works as chemical engineer in 1930. His progression through various positions in production and development of rubber and plastic insulated wire and cable has been marked by the obtaining of many patents and improvements and he has at this time seven patents pending in his name.

Mr. Gray was presented the McGraw award a year ago at the National Electrical Manufacturers Association convention, and he was given the Manufacturers' Medal and Purse for his distinguished contributions of new knowledge and processes and of broad influence on the technology and progress of the electrical industry.

Mr. Gray plans to continue his work in the field by special arrangements which will take him first to Japan and later back to this country. He has sold his historical farm in Maryland and plans extensive travel around the world with his wife accompanying him.

United Carbon Elects

United Carbon Co., Charleston, W. Va., has elected several new officers for its three major operating subsidiaries. R. W. French, president and director of the parent company, was elected president of United Carbon Co., Inc., and executive vice president of United Rubber & Chemical Co.

A. G. Treadgold was chosen senior vice president of United Carbon Co., Inc.; and H. E. Norrick was named senior vice president of United Producing Co., Inc. John H. McKenzie, director of research and development for United Carbon and all subsidiaries, was made vice president of United Carbon Co., Inc., and of United Rubber & Chemical, and was elected a director of all three companies.

Harold B. Lawson, an officer and controller of the parent company, was elected to board membership of the three subsidiaries. Also, he was named assistant secretary and assistant treasurer for both United Carbon Co., Inc., and United Producing, and secretary and assistant treasurer for United Rubber & Chemical. Frank Lindeman, Jr., general manager of oil and gas operations for United Carbon, was made executive vice president and a member of the board of United Producing and a director of the other two major subsidiaries.

John M. Capito, manager of Appalachian Area oil and gas operations, and Cramon Stanton, manager of exploration, were elected vice presidents of United Producing.

Neoprene in Asphalt Cuts Skid Danger

Quicker stopping in locked-wheel skids gives greater safety on roads where neoprene has been added to asphalt surface treatment, according to tests reported by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

In panic stops at 40 m.p.h., a test car averaged 94.5 feet braking distance before coming to a complete halt on unmodified asphalt and stone chip surfaces of the type commonly used for maintenance on public roads, plant sites, and military posts. On a road where 1½% of neoprene had been added to the asphalt, braking distance was only 82.7 feet, an added safety factor of 12.5%, or more than half of a car's length.

The increased stopping efficiency of the neoprene-treated road surface in a 30-mile-per-hour test resulted from the new material's higher coefficient of friction which was determined to be 16% greater than that of conventional material. The advantage resulted from neoprene-modified coating's greater ability to hold stone chips and decreased bleed-through to the surface. When asphalt bleeds and coats the top of surface chips, decreased friction and lower braking efficiency result.

The tests showed that the differential in braking effectiveness on the improved surface increased with speed. At 20 miles per hour, braking distance for the neoprene-modified paving was only 3/10 of a foot shorter. At 30 miles per hour, the difference was almost seven feet, and reached the 12-foot range at 40 miles per hour. Tests also showed that wet pavements did not reduce superiority of the neoprene-modified asphalt, with an advantage of 6 5/16 feet recorded for the modified paving material at 27 miles per hour.

Testing was done on a road laid by the Delaware Highway Department in August, 1957, in a controlled test of the improved road building material. Both neoprene-modified and control sections had been in service for almost a year when the tests were made in 1958.

Accurate measurements of distances and time were made through use of an electric timer mounted in the car, a special speedometer connected to a fifth wheel behind the car, and an explosive cartridge on the rear bumper to fire a pellet of yellow paint on to the road surface the instant the brake was applied.

Chemetron Acquisition

Chemetron Corp., New York, N. Y., has entered into an agreement to purchase certain assets of Cardox Corp.'s carbon dioxide division, chlorine dioxide division, and fire equipment division. Cardox is one of the major United States producers of carbon dioxide products.

This acquisition will be operated as the Cardox division of Chemetron Corp. and will be headed by Cardox president, R. T. Omundson. The move increases Chemetron's proportion of business in consumable and less cyclical products and extends its marketing of carbon dioxide and dry ice into 14 additional states, stated Chemetron president, Charles J. Haines.

Chemetron is obtaining the assets of the three Cardox divisions, together with Cardox's interests in the subsidiary Dean-Cardox, Witt Ice, and General Carbonic, in exchange for 165,000 shares of Chemetron common stock and $2 million in cash. Other divisions and assets will remain with the present Cardox Corp. No changes in personnel are planned in the divisions being acquired by Chemetron.

Cardox Corp., a subsidiary of Marmon-Herrington Co., Inc., is one of the world's largest producers of low-pressure carbon dioxide fire-fighting systems. It also produces fire detection systems, CO_2 bulk liquid storage systems, CO_2 rubber tumbling systems and other equipment. Cardox's headquarters are in Chicago, Ill.

Chemetron produces industrial and medical gases, welding and cutting equipment, medical equipment, welding fittings and flanges, closed and open-die forgings, food and chemical processing equipment, and chemicals, and designs and constructs complete chemical and petroleum processing plants.

Midwest Reclaiming's Report Wins "Oscar"

Midwest Rubber Reclaiming Co., East St. Louis, Ill., was awarded a bronze "Oscar of Industry" for the best annual report for 1957 in the rubber and tire industry at the annual awards banquet on October 27, sponsored by the investment and business weekly, *Financial World*.

Mr. Painter accepts a bronze trophy from Richard J. Anderson, *right*, editor and publisher of *Financial World*, at the fourteenth annual awards banquet

Howard R. Painter, Midwest's executive vice president and treasurer, accepted the trophy at the banquet in New York City's Hotel Astor.

The competition included approximately 5,000 annual financial reports from all industries, and this year is the eighteenth that *Financial World* has reviewed corporate annual reports in order to select outstanding reports in various industries. Entries are separated into classifications by industry and judged for clarity, readability, and attractiveness of design. Runners-up in the rubber and tire classification included United States Rubber Co., which placed second, and Goodyear Tire & Rubber Co., which took third place.

Midwest's winning report was compiled by the accounting firm of Price-Waterhouse. The company's advertising agency, Gordon-Marshall, Inc., was responsible for layout and design.

New Three-T-Fleet Test

Three-T-Fleet, Inc., Odessa, Tex., is now offering a screening road-wear test to bridge the point where laboratory tests end and where road tests begin. The purpose of the screening test is to furnish information that will enable the investigator to select the most promising leads of tire-tread-type compounds for more detailed and exhaustive road tests. The screening test is not a substitute for a road test. It is designed to help the investigator run more meaningful road tests when full-scale road tests are run.

Laboratories desiring to use this service will forward laboratory mixed tread-type compounds containing vulcanization, reinforcement, softener, and antioxidant ingredients to Three-T-Fleet's test center at Marfa, Tex. Tread sections will be cold pressed, then used to top cap passenger tires. Tires will be vulcanized in equipment especially designed for the screening test and then road tested in a controlled road test.

Where only a very limited amount of tread stock is available, 5.20-13 tires will be used. If a relatively large amount of tread stock can be prepared at a low cost, 7.50-14 tires will be tested. The 5.20-13 curing matrix is a special matrix having a skid depth of only 5/32-inch; while the 7.50-14 matrix has a standard skid depth of 11/32-inch.

Detailed information of the screening road test including stock data, control information, curing time and temperatures, test routes, inspections, reports, correspondence, and costs is available upon request from the company.

PPG International S.A.

Pittsburgh Plate Glass Co., Pittsburgh, Pa., has established a new wholly owned international subsidiary to be known as Pittsburgh Plate Glass International S.A., a Swiss corporation with its home office in Geneva, Switzerland. The purpose is to integrate all phases of international business of the Pittsburgh Plate organization, including licensing, investment, manufacturing, and marketing functions. Immediate plans involve licensing, marketing, and investment functions; it is expected the overseas operations eventually will include facilities for the production of glass, paints, chemicals, and related products.

Switzerland was selected as the site of the home office because of the stability of currency and politics, its central location in Europe, traditional neutrality, and excellent international banking facilities. Geneva was chosen as a truly international city as well as a center for air, rail, and wire communications.

Also, Havana, Cuba, has been chosen for a branch office of the international subsidiary for the administration of sales of glass, paint and related products. Located strategically in Latin America and near the United States plants of Pittsburgh Plate and its subsidiary, Columbia-Southern Chemical Corp., the Havana office will serve its customers most effectively commencing shortly after the first of the year.

E. T. Asplundh has been elected chairman of the shareholder's executive board and of the board of administrators of the international subsidiary. Other officers are Bjorn Holmstrom, vice president and technical director, who will be in charge of the Geneva office; John H. Henshaw, vice president in charge of glass and paint sales, and glass technology; Sidney W. Dodge, vice president, finance; and Maurice W. Hibschman, vice president and general counsel. The last three will have their headquarters at the Havana office.

Thiokol-ARS Award

Frederick R. Reardon, graduate student of rocket science at the Forrestal Research Center, Princeton University, has been named winner of the first annual Thiokol-American Rocket Society Achievement Award for Advanced Study in Rocket Science. The announcement was made by the sponsors, Thiokol Chemical Corp. and ARS, who established the award to assist materially gifted university students to pursue advanced study in rocket science.

Reardon received his award—a gold medal and $1,000 scholarship—on November 19 at the ARS Honors Night dinner in the Statler-Hilton Hotel, New York, N. Y. In naming young Reardon, the awards committee cited him for his advanced work in liquid propulsion rocket motors, during which he developed a unique fuel control system which has become a standard tool of great importance to the industry.

Reardon expects his doctorate degree in June, 1960, following which he plans to teach university-level science and engineering with emphasis on rocket propulsion systems.

"Although I am aware that men with such training as mine are in great demand by the industry," he explained, "I feel there is an even greater need for teachers."

Joseph Crosby, president of Thiokol, applauded Reardon's decision saying:

"Our industry's need for trained engineers today must be tempered by the greater demands of tomorrow. Our prime concern must always be the continued advancement of the state of the art. To this end we must look to the thousands of science-minded young people who are about to enter our universities. We must help encourage and materially assist those who seek and are qualified for advanced studies. But first, we must have qualified, dedicated teachers who can train and inspire them."

Wm. Walker Retires

William E. Walker

William E. Walker retired October 31 after 37 years' service with B. F. Goodrich Footwear & Flooring Co., Watertown, Mass. His associates gave him a party and presented him with an automatic camera and projector.

Mr. Walker was graduated from Tufts College in 1919 with a B.S. degree in chemical engineering. In 1921 he started with BFG Footwear Flooring Co. (then Hood Rubber Co.) as a laboratory assistant and rapidly worked his way up to technical supervisor, technical superintendent, and, finally, in 1951, manager of technical services, research, and development. During his career he was instrumental in developing the Hygeen Insole in canvas footwear and many other important features which have been firsts in the industry.

Mr. Walker is a member of the American Chemical Society; Rubber Division of the ACS; Corinthian Yacht Club, Marblehead; and treasurer, Class of 1918, Tufts College. He and Mrs. Walker plan a trip to Florida this winter and in April, 1959, they plan to tour Europe.

South Haven Expands

Even though it is still less than three years old, the South Haven Rubber Co., South Haven, Mich., has announced the completion of 25,000 square feet of added production facilities. Original production of custom molded items for the automotive and industrial trades started in January, 1956. A year and one-half later, on November 1, 1957, work commenced on the new addition. Larger areas for mixing, curing, and finishing operations were included in the new wing to allow more efficient operation and control of quality.

Officers of the company were reelected at a recent annual meeting of the company. C. R. Spencer was named president, with George D. McCarthy, vice president and sales manager, C. H. Skuza, vice president and technical director, A. B. Vidmar, secretary-controller, and J. H. Nieberding, treasurer. All of these officers were also reelected directors.

Expanded plant of South Haven Rubber Co.

John L. Cohill

J. J. Robson

Mario Di Federico

L. J. Campbell

Naugatuck-Bayer Pact

Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn., and Farbenfabriken Bayer, A.G., one of Germany's largest chemical firms, have jointly agreed to exchange know-how and patents on chemical which are used in the manufacture of rubber products.

Under the terms of the agreement the two companies will pool technical knowledge and research resources to tackle problems in the field of rubber chemicals. The intent of the agreement is to speed the development of chemicals that will improve the service life and usability of rubber.

Chemicals are used in the manufacture of every rubber product to change the properties of the basic rubber to make it fit the needs of a specific use.

Naugatuck Chemicals is one of the largest manufacturers of these chemicals in the United States. It makes approximately 65 chemicals used in the manufacture of rubber items. The Bayer firm is the leading producer of these chemicals in Europe and distributes its rubber chemical products throughout the world.

Firestone Ups Four

The Firestone Tire & Rubber Co., Akron, O., recently announced four top echelon promotions. In the move, John L. Cohill becomes vice president—special assignments, a new post in the company. L. J. Campbell leaves the presidency of the Firestone Steel Products Co. to succeed Cohill as vice president of all company subsidiaries other than tires; and Mario Di Federico succeeds Campbell as the Steel Products company president. He was vice president in charge of sales of the company.

J. J. Robson was appointed director of tire engineering and development, succeeding the late Walter E. Lyon.

Cohill, a veteran of 38 years with Firestone, was named vice president of the Firestone International Co. in 1946, assistant to the president of the parent company in 1949, and for the past two years has been vice president of all company subsidiaries other than tires.

Campbell, with Firestone since 1942, went with Steel Products in 1945 as assistant treasurer and assistant secretary, a position he held until 1951 when he was named vice president of the company. In 1952 he became the company president.

Di Federico, vice president in charge of sales for Steel Products since February, 1958, joined the company's engineering department in 1947. He was named head of the manufacturing engineering department in 1951 and became Akron factory manager in 1954.

Robson was assigned to the West Coast as manager of manufacturers' sales for the Firestone Tire & Rubber Co. of California in 1946. He returned to Akron in 1949 as manager of tire engineering. Four years later he was named manager of the combined tire engineering and development departments.

NEWS BRIEFS

The Dayton Rubber Co., Dayton, O., has developed a special formulation of urethane foam that is being used to protect the nose cone of the Thor missile during shipment. Liquid chemicals are poured into a mold of the nose cone's outer surface. The resulting foaming action quickly forms a low-cost, lightweight, protective package that fits like a glove. The semi-rigid urethane foam gently cradles the nose cone and cushions it from shock, assuring arrival at the launching site in perfect condition.

United States Rubber Co., New York, N. Y., has announced that effective, October 27, prices for Koylon foam rubber cushioning and flat stock will be increased on all shipments made to furniture manufacturers on and after November 24. The price increases will average from 7-12% higher, according to Jack L. Bonnell, sales manager.

The Goodyear Tire & Rubber Co., Houston synthetic rubber plant, Houston, Tex., has now completed the extensive expansion program of its plant facilities at Houston with the recent installation of four gas-fired, three-pass synthetic rubber dryers. All four dryers were designed, built, and erected by C. G. Sargent's Sons Corp., Graniteville, Mass.

Cleveland Ball Bearing Co., Cleveland, O., has been appointed an authorized distributor for industrial Gask-O-Seals and industrial Stat-O-seals by the Parker Seal Co., a division of Parker-Hannifin Corp., Cleveland, O., and Culver City, Calif. The new-type seals are being stocked in quantity by the distributor to assure prompt servicing of customer requirements. Technical assistance on sealing problems is offered by personnel of both companies.

Pittsburgh Plate Glass Co., Pittsburgh, Pa., has received all the assets of the Barium Reduction Corp., South Charleston, West Va., in exchange for shares of its stock. The transaction was November 17, 1958, according to David G. Hill, president of Pittsburgh, and Thomas B. Jackson, president of Barium. Management, operation, and sales of the products will be handled by the Columbia-Southern Chemical Corp., division of Pittsburgh Plate Glass. Barium's products include barium chemicals, related by-products, and carbon bisulfide for the glass, ceramic, paper, leather, rayon, petroleum, and general chemical industries.

The Goodyear Tire & Rubber Co., aviation products division, Akron, O., has announced a new and larger inflatable raft for use in the new commercial jet airliners. The new raft carries 25 persons and is marketed under the trade name RaftAir. These rafts are manually inflated, made of two-ply rubberized nylon, and are equipped with fishing equipment, flares, first-aid devices, signaling mirrors, dye markers, flashlight, knife, sea anchor, and rations including fresh water. Flight crews are being trained in the use of the rafts prior to operating the jets overseas. The RaftAir is the largest life raft available for these large planes, but deflated is packed in a protective self-opening coated nylon envelope which is very lightweight and compact for easy handling.

The General Tire & Rubber Co., Akron, O., has added a new high-speed winter tire for year-round use. L. A. McQueen, company vice president, in announcing the new tire, also stated that General expects the sale of winter tires to set new records owing to the continuing drive for highway safety. The new tire will be known as the "Safety Winter Cleat" and will be produced in addition to the "Winter Cleat" tire featured previously. Both tires will be included in the company's snow traction guarantee which has been in effect for the past several years with its snow tire lines. The new tire utilizes a continuous tread design, for long, quiet, easy-riding performance, along with deep, angled, siped cleats for traction through snow and mud and over wet or icy streets. Also featured is the use of General's Nygen cord in the body construction.

Avels Sales & Engineering Co., Indianapolis, Ind., has been franchised as a distributor for industrial Gask-O-Seals and industrial Stat-O-Seals by the Parker Seal Co., division of Parker-Hannifin Corp., Culver City, Calif., and Cleveland, O. Avels has been a leading distributor of Parker synthetic rubber O-rings and Parker tube and hose fittings for the past several years.

Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn., has developed a special natural rubber adhesive which is being used on a tape made by Mystik Adhesive Products Inc., Chicago, Ill. The new tape, called Protecto-Mask, is a paper-backed, self-adhering tape designed for protecting surfaces of formed metal products from scratches and effects of weather. The protection is provided from the sheet metal preforming stage until the formed products are installed. The adhesive of the tape forms a protective film on the metal surface that prevents scratches, rusting, oxidizing, or staining even when the paper covering is ruptured in a bending or forming operation. Supplied in rolls of 100 or 200 yards, and in widths ranging from ½-inch to 48 inches, the tape is quickly rolled on to flat metal surfaces in fabricating plants either manually or mechanically.

Bennett-Rosendahl Co., Inc. New York, N. Y., has been founded as an advisory company to small and medium-size chemical companies in all business matters connected with the running of a chemical company. Harry Bennett and Edward Rosendahl, having served as president and executive vice president respectively of Glyco Products Co., Inc., for 30 years are well qualified to direct this new venture. With offices located at the Coliseum Towers, 10 Columbus Circle, New York 19, the new company offers advice on organization of sales or purchasing sections, publicity, catalogs, personnel problems, plant safety, foreign agencies, public and private finance, and sale or merger plans.

Para-Chem, Inc., Philadelphia, Pa., has appointed Ralph Gossett Co. to be southern representative for the sale and distribution of Para-Chem products. The seven salesmen of the Gossett organization will be assisted by James E. Kerr, of Para-Chem, as technical advisor and will be backed by the technical information of Para-Chem's Philadelphia laboratories. The addition of the latex compounds sold under the trade name Paranol marks the entry of the Gossett firm in the wet processing field.

Commercial Solvents Corp., New York, N. Y., has been able to modify its processing in its Terre Haute, Ind., methylamine plant, with a result that the capacity has been more than doubled. Increased applications for industrial use of monomethylamine, dimethylamine, and trimethylamine in textile, rubber accelerator, rocket, photographic and medicinal fields as well as others have created a strong demand over the days when unhairing of hides in tanning was the chief usage. The plant, initially on stream in 1957, is a modern, continuous, instrumented and automatically controlled installation.

Thiokol Chemical Corp., Reaction Motors Division, Denville, N. J., has been awarded a prime contract for further development of a series of prepackaged liquid rocket powerplants by the Navy. The Bureau of Aeronautics will supervise the project which is designed to develop larger and more powerful versions of the prototype now going into production. The design principles of the prepackaged power-plant were established by Reaction Motors and are expected to furnish a family of liquid propellant rocket engines for virtually all missile applications. The new engine is designed to be complete as delivered to the field and is ready for firing as soon as installed in the missile.

C. B. Hunt & Son, Inc., Salem, O., manufacturer of air and hydraulic control valves, has changed its name to Hunt Valve Co., to identify its name more closely with its products. Several of its new control valves, fully designed and now undergoing final tests, are expected to be introduced within the next few months.

United Ultramarine & Chemical Co., Inc., New York, N. Y., has been formed to market in the United States the full range of ultramarine blue pigments and allied chemicals made by the parent company, Vereinigte Ultramarin Fabriken A.G., Cologne, Germany. These products were sold through the American Cyanamid Co., pigments division, since Cyanamid ceased its own manufacture. Now in line with its current policy of concentrating on products actually manufactured, Cyanamid has discontinued the resale of these products. The new company will have agents and warehousing throughout the United States and Canada. Officers of the company are: C. Erwin Leverkus, of the parent firm, chairman of the board; Otto C. Leverkus, managing director of Vereinigte, president; William F. Siemon, Jr., executive vice president; and two directors, W. Topkin and R. Koch-Weser, of the New York law firm of Topkin & Farley.

Owen-Richards, Inc., Birmingham, Ala., and an associated firm, Bearings & Transmissions Supply Co., Inc., Mobile, Ala., have been appointed authorized distributors of Parker Seal Co.'s synthetic rubber O-rings for sealing applications. Parker Seal is a division of Parker-Hannifin Corp., Cleveland, O. According to William Spencer, III, president of the distributing firms, both outlets will carry extensive stocks to assure prompt handling of customer requirements. Joe H. Hamner heads the Mobile company, which has a branch operation in Pensacola, Fla. Technical assistance on sealing design problems will be extended to the distributors' customers as needed by R. R. Braucher, Parker Seal Co., representative in the Southeast.

News Briefs

The General Tire & Rubber Co., Akron, O., has installed a new wet collector to remove volatile dust in the area where tire lubricant is sprayed on the green tires. The use of this Pangborn Ventrijet collector has solved the problem of effectively collecting the gasoline dust and separating it from the spray booth and has aided very much in reducing plant housekeeping in the area. The collected dust can be salvaged or discarded.

Western Insulated Wire Co., Los Angeles, Calif., has announced additions to plant, equipment, and technical staff. The company, now celebrating its twenty-first year of operation, manufactures Bronco 66 certified portable electrical cords and cables. The additions are expected to serve better the needs of the firm's customers.

The Detroit Shoe Retailers Association's dinner-dance to honor past presidents had a family flavor. Nathan, Leonard, and Morton Hack, of the Hack Shoe Co., and the Kipple Sole Corp., Detroit, Mich., have each served as president of the group. Nathan Hack, founder of the company and developer of the Ripple sole, attended from California.

H. K. Porter Co.'s Quaker Rubber Division, Philadelphia, Pa., is offering a new 16-mm. color and sound movie, "Progress in Industrial Rubber Products," describing the operation of a modern rubber plant. The 25-minute film reveals how raw materials are used to produce quality rubber products through improved production facilities. It describes the process of making such vital products as conveyor belts, wrapped and molded hose, fire hose, escalator hand rails, and electrical insulating tapes. Arrangements for showing the film can be made by contacting the advertising department of the company.

United States Rubber Co., New York, N. Y., has developed a complete line of high-speed aircraft tires for American jet airliners. The tires are for the Boeing 707, now in service; the Lockheed Electra turbo-prop, which entered service in November, and the Boeing 720, Douglas DC-8, and Convair 880, earmarked for delivery in 1959. Made with nylon tire cord, the tires are tubeless for lighter weight, cooler running, and greater protection against blowout. They are qualified for maximum landing and take-off speeds up to 200 miles per hour, carrying loads up to 35,700 pounds each, depending on the size of the tire.

Puratize, Inc., a subsidiary of Gallowhur Chemical Corp., Ossining, N. Y., has developed a process to render plastic materials bacteriostatic and self sterilizing. The company plans to license the process to producers of molding compounds and to molders. Major markets for Puratized plastics is expected to be in the production of garbage cans, bathroom fixtures, and floor tiling. The process involves the addition of custom-made bacteriostats to the resin, colorant, or plasticizer. Puratize, Inc., supplies the additive and formulation recommendations without charge. The licensee, who is permitted to use a Puratize label on his products pays a fee based on the number of units so produced.

Wellco Shoe Corp., Waynesville, N. C., has asked the footwear trade's, particularly retailers', cooperation in maintaining the status of the trade mark "Foamtread" in the sale and advertising of footwear manufactured by the firm. Wellco states that "Foamtread" is its registered trade mark referring to sponge-rubber soled slippers and casuals that it manufactures. The name is not a generic term referring to either a type of footwear or a method of manufacture.

New $2,500,000 plant for the manufacture of B. F. Goodrich adhesives. Located in Akron, O., the two-story plant contains 70,000 square feet of floor space and houses a development laboratory in addition to modern production facilities. Approximately 100 persons are employed here.

Union Carbide Chemicals Co., Division of Union Carbide Corp., New York, N. Y., has relocated two of its district offices. The Atlanta and Buffalo district offices now have new addresses and telephone numbers. In Atlanta it is 1371 Peachtree St., N.E., Atlanta 9, Ga., with telephone number TRinity 3-2241 and in Buffalo, 4446 Main St., Buffalo 26, N. Y. with the telephone CIrcle 4040.

The Goodyear Tire & Rubber Co.'s aviation products division, Akron, O., is producing fuel cells and water injection cells for Boeing B-52G missile platform bombers, first of which was flown October 26. Dollar value of the subcontracts is in excess of $23,000,000. Quantity production is expected to extend through 1960. Center wing sections, life raft doors and top panels are being made at its Litchfield Park, Ariz., facility. Also, the company is producing B-52G nose sections, including radomes, as well as belly radomes. The B-52G Stratofortress is America's first heavy jet bomber designed to serve as a launching platform for supersonic guided missiles.

Parker Seal Co., a division of Parker-Hannifin Corp., Cleveland, O., has granted a franchised distributorship on industrial Gask-O-Seals for pipe flanges and industrial Stat-O-Seals for bolts and other fasteners to Dixie Bearings, Inc., Atlanta, Ga. Stocks of the new-type seals for prompt handling of customer requirements are being established in all Dixie branches. Dixie also continues as an authorized distributor of Parker synthetic rubber O-rings.

The California Division of The Pantasote Co., Passaic, N. J., has moved its headquarters to a new 20,000-foot warehouse at 4703 E. 48th St., Vernon Calif. Jules Pilcher, manager of the California Division, said that the new facilities will enable the division to stock a minimum inventory of ½ million pounds of vinyl resin and to start production of the company's Panta-Pak trays on the West Coast. Mr. Pilcher announced that the following resins, produced by the Eleanora Chemical Division of the company, would be stocked on the West Coast: Kohinor 648, Kohinor 652, and Kohinor 640.

Société des Talons Wood-Milne, largest sole and heel rubber manufacturer in France, has been granted exclusive rights to manufacture Ripple Soles in France, for distribution in that country, Algeria, and Tunisia. The addition of Wood-Milne to the list of licensees brings the number of countries now making Ripple Soles to seven, according to Leonard Hack, president, Ripple Sole Corp., Detroit, Mich.

Commercial Solvents Corp., New York, N. Y., has opened bulk storage facilities for 2-nitropropane at Newark, N. J., and at Los Angeles, Calif. The use of this solvent in the protective coating field for polymeric materials such as epoxy, vinyl, and acrylic resins has caused a sharp increase in demand and has led the company to add these new facilities. Previously bulk shipments were made only from the company's plants at Sterlington, La., and Peoria, Ill.

Ace Rubber Products, Inc., Akron, O., is now manufacturing White Kleen Sweep Matting for hospitals, institutions, and marine installations. The Kleen Sweep design, modern and easy to sweep, mop or scrub, is said to be the easiest to clean of any type of safety matting. The white rubber and deep rib design give sure, quiet footing while protecting floors. While basically the function of the matting is safety and floor protection, the company stated that this product was created upon requests to serve a great need in the fields where clean and neat appearance are of importance.

The Goodyear Tire & Rubber Co.'s foam products division, Akron, O., recently announced price increases on foam cushioning, effective December 1. The increases, according to the company, will vary according to different sizes or types of cushioning, but will be at a minimum of approximately 10%.

Davidson Rubber Co., Charlestown, Mass., has developed new one-piece urethane foam armrests which are being used in volume for the first time in 1959 automobiles. They are said to be easier to install and have better wearing qualities because they are molded in one piece, into a polyvinyl chloride shell. Profile Rubber Products, Inc., Dover, N. H., the manufacturing arm of Davidson, will expand the use of urethane foam to other products as the technology for making these parts is developed. The essential raw material used in the foam is being supplied by Du Pont.

Cat's Paw Rubber Co., Inc., Baltimore, Md., has introduced a new line of lightweight platform wedges for Ripple soles, called Featherwate Platforms. This new line fills an increasing need of especially lightweight platforms that will cement effectively and permanently to the Ripple sole and upper. The new platform shoes, varying in thickness from 9 to 36 irons, can be supplied either cut to size or in 36- by 36-inch sheets so that shoe manufacturers can fabricate their own platforms if they prefer. Colors will match or contrast with the Ripple sole.

Thiokol Chemical Corp., Reaction Motors Division, Trenton, N. J., announced a new series of prepackaged liquid propellant rocket power plants at a press conference held November 17, on the first day of the American Rocket Society meeting in New York. The major features of the motor brought out at this session were the immediate readiness and reliability of the motor. It was also claimed by the company that the price of these rockets would be considerably less than those presently in use. These rockets require no field loading since all materials are factory installed. This permits immediate firing when desired. The "family" of rocket motors can be scaled to any desired size with a minimum of development time and expense. The power plants known as Guardian I and Guardian II are now in production or development and are expected to fill many roles in missiles of the future.

Raybestos-Manhattan, Inc., has moved its San Francisco district warehouse and offices from 131 Mission St. to new and larger quarters at 168 Beacon St., South San Francisco, Calif. The new facilities will provide better service for customers of five divisions: Manhattan Rubber Division, Raybestos Division, Packing Division, Asbestos Textile and Plastics Products divisions.

NEWS about PEOPLE

Walter R. Kosy

Walter R. Kosy has joined Marbon Chemical, Washington, W. Va., a division of Borg-Warner Corp., as a technical service representative for Detroit and eastern Michigan. He had been with General Industries Co., Elyria, O., as a sales engineer selling plastic parts to the automotive industry.

William H. Steinberg, technical consultant and recently sales manager of the abrasive wheel department, retired after 41 years with the Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J. He started as a development engineer in the abrasive wheel department in 1917, becoming sales manager some time later. He made probably his largest contribution to industry in connection with the development of Manhattan's line of the cut-off wheels. He was recognized as an authority on this-type wheel by the industry which secured his help, as a member of the safety committee of the Grinding Wheel Institute, in writing the Safety Code adopted by the American Standards Association.

Jan Visscher, rubber chemist, has joined the laboratory of Western Insulated Wire Co., Los Angeles, Calif. A native of Holland, he came here in 1957. In his new capacity, he will keep Western abreast of wire and cable developments in foreign countries. **Hugo Biskeborn,** originally from Europe and Canada, is now working on advanced cable design problems in the Bronco engineering department of Western. Also a new member of Western's technical staff is **K. D. Champagne,** a native of Montreal, P.Q., Canada.

E. P. Schrank, manager of production and engineering at Seiberling Rubber Co., Akron, O., has been elected chairman of the Akron Section, American Society of Mechanical Engineers.

A. E. Whitney, Jr.

Robert M. Hill

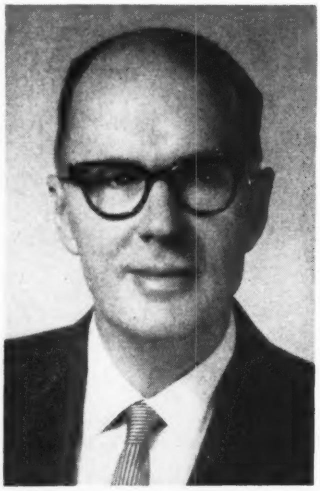
Leighton Riess

A. E. Whitney, Jr., has been assigned to the newly created post of regional sales manager-vinyl resins for the chemical division of the Goodyear Tire & Rubber Co., Akron, O. He has been serving as special representative in the New York district and in his new post will continue to make his headquarters in the New York office. Whitney will be responsible for the coordinating of all sales service, development, and field sales for vinyl resins in the eastern part of the country, according to C. O. McNeer, general sales manager. The move was prompted by the need of more effective liaison between the chemical division and its manufacturing customers.

Harlan A. Hashbarger has been appointed to the newly created post of director of divisional planning for the organic chemicals division of Monsanto Chemical Co., St. Louis, Mo. **Desmond B. Hosmer** will succeed him as manager of production planning and control for the division. Mr. Hosmer's previous position of plant manager at Anniston, Ala., will be filled by **Robert A. Pohl,** who was general manufacturing superintendent at the William G. Krummrich Plant, Monsanto, Ill. **John R. McClain,** plant engineer at Nitro, W. Va., has been appointed to fill that manufacturing superintendent post at the Krummrich plant.

W. L. Grignon has been named technical sales representative by the Naugatuck Chemicals Division of Dominion Rubber Co., Ltd., Elmira, Ont., Canada, and will service the central Ontario area. He joined Dominion Rubber in 1943 and has had experience in latex, rubber dispersions, and reclaimed rubber in both quality control and production. He has been serving since 1952 as a sales representative for the latex and reclaim division in Quebec, Ontario, and the Maritimes.

S. William Riley, formerly chief project engineer, has been appointed chief engineer for the Quaker Rubber Division, H. K. Porter Co., Inc., Philadelphia, Pa. He will be responsible for all engineering at the Philadelphia plant. Before joining Quaker in January of this year, Riley was design engineer with McNeil Machine & Engineering Co. and supervising engineer with The B. F. Goodrich Co.



S. William Riley

Clifton D. Crosby has been appointed assistant manager, sales analysis, for Union Carbide Chemicals Co., division of Union Carbide Corp., New York, N. Y. He was formerly a market analyst in the market research department. Announcement was also made of the appointment of **Robert H. Hoffman** as supervisor of mechanical reproduction in the sales analysis department. He was transferred from sales representative in the Newark area.

Leighton Riess is the new manager of compounding and processing for Mohawk Rubber Co., Akron, O. He was formerly with development and foreign departments of the Goodyear Tire & Rubber Co. He will assume the duties previously performed by **Robert M. Hill,** who has been promoted to technical manager of Mohawk's Akron plant. Hill was formerly manager of tire compounding. Another change in the technical staff at Mohawk sees **Frank M. Johnson,** who was chief chemist at the Akron plant, going to the company's Helena, Ark., plant in the same capacity. Johnson has worked in various phases of development work and was named chief chemist in February, 1958.

Howard R. Erwin has been elected a vice president of Midwest Rubber Reclaiming Co., East St. Louis, Ill. He has been a director of the company since May, 1957, and has been production manager for the three Midwest plants since January, 1958. Mr. Erwin started his career in the synthetic rubber industry as manager of the Kentucky Synthetic Rubber Co., and in 1953 he became deputy director of the Federal Facilities Corp. Following the sale of the plants to private industry he joined Midwest Rubber Reclaiming as manager of its Paramount, Calif., plant. In January, 1958, he was appointed production manager with headquarters in East St. Louis and has responsibility for the East St. Louis plant as well as those in Barberton, O., and Paramount.

Roger S. Firestone, president of Firestone Plastics Co., Pottstown, Pa., and a director of The Firestone Tire & Rubber Co., Akron, O., was recently reelected president of United Cerebral Palsy Associations, Inc., at the organization's ninth annual conference in Washington, D. C.

Harold D. Bond

E. R. Mako

Charles F. Ashcroft

Harold D. Bond has been named a western technical sales representative for the elastomer chemicals department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. He will be headquartered in Los Angeles and will serve customers in southern California, New Mexico, Arizona, and Nevada. Bond, who has had extensive experience in the aircraft industry, joined Du Pont in 1953.

W. E. Crouch has been named manager of the automotive and allied products department of the U.S. Tires division of United States Rubber Co., New York, N. Y. **Walter F. Brown,** general sales manager of the division, announced that Mr. Crouch would be responsible for the development of merchandising programs for selling batteries, accessories, and anti-freeze through independent tire dealers, petroleum marketers, and other sales outlets.

C. E. Hart has been made manager of the Paramount, Calif., plant of the Midwest Reclaiming Co., East St. Louis, Ill. He replaces Howard R. Erwin, who transferred to become production manager for the entire company. Mr. Hart started with the company when it was the Akron Rubber Reclaiming Co. and was a foreman with the East St. Louis plant when it went into operation in 1928. He went to the Paramount plant in 1956 as factory manager and since January, 1958, has been acting manager.

William P. Denson, Jr., has been named technical representative for Copolymer Rubber & Chemical Corp., Baton Rouge, La. As technical representative, he will handle technical and sales service activities for the company, operating from the Baton Rouge plant.

E. R. Mako has been appointed Midwest representative for General Magnesite & Magnesia Co., Plymouth Meeting, Pa. He was formerly sales manager with Manufacturers Chemical Co. and specialized in chemical specialties and latex compounding. He will make his new headquarters in Cleveland, O., offering new magnesia chemicals to the steel, rubber, and related industries.

Raymond H. Marks

Raymond H. Marks, sales manager, has been appointed vice president in charge of sales for Cary Chemicals, Inc., East Brunswick, N. J. He replaces **Thomas Zawadzki,** former sales manager, now vice president in charge of product development. Marks joined Cary as sales manager in February, 1958.

Robert L. Feldman has been elected executive vice president of the Golden Bear Oil Co., Los Angeles, Calif.

Charles F. Ashcroft has been named assistant western regional sales manager for Godfrey L. Cabot, Inc., Boston, Mass. Mr. Ashcroft joins **Donald Simonds,** recently appointed manager, in setting up Cabot offices in the Texaco Bldg., Room 718, 3350 Wilshire Blvd., Los Angeles 5, Calif. A member of the Army Air Force during the war, Mr. Ashcroft has been very active in the rubber industry in California for many years. He is a member of The Los Angeles Rubber Group, Inc. A native of Pasadena, Calif., he attended Pasadena Junior College and the University of Southern California.

Edward J. Geise has been appointed assistant manager of commodity sales for the Naugatuck Chemical Division, United States Rubber Co., New York, N. Y. **Robert P. White** will succeed Mr. Geise, as sales manager of Vibrin polyester resin. The position of technical sales representative for plastics in the Boston area formerly filled by Mr. White will be taken by **Amico J. Lombardi,** formerly technical sales representative for intra-company sales. Mr. Geise will report to **Albert W. Holmberg** manager of commodity sales for the division, and will assist in directing the group of commodity sales manager who supervise sales, promotion, advertising, and planning for the division's 300 products.

Herndon Howard has been advanced from assistant manager to manager of the Dallas, Tex., sales district for the Seiberling Rubber Co., Akron, O. He succeeds **H. J. Bobbitt,** who is going to devote his full effort to special sales work for the company. Bobbitt served as district manager for Seiberling at Dallas for almost 25 years; while Howard, who started with the company at Dallas in 1952, was later sent to the Chicago district and then back to Dallas as assistant district manager.

George B. Cotton

Daniel J. Rowe

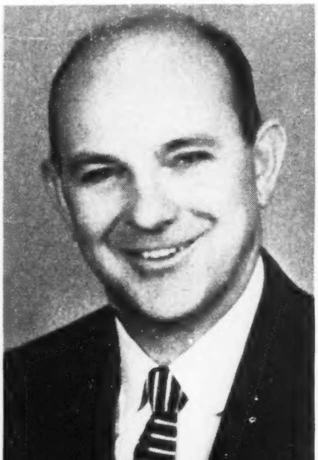
James Steiner

George B. Cotton has been appointed manager of technical services at the B. F. Goodrich Footwear & Flooring Co., Watertown, Mass., to replace **William E. Walker,** retired. Cotton joined the company in 1941, left for four years with the Army, and returned in 1946 as a technical aide and progressed to technical supervisor; production superintendent, aeronautical; manager, compounding—special products. He was appointed assistant manager technical services on March 1, 1958.

Robert D. Huntoon has been appointed to the post of Deputy Director of the National Bureau of Standards, United States Department of Commerce, Washington, D. C. He will serve as alternate to the Director, Allen V. Astin, in external matters. Dr. Huntoon, who was active in the development of the radio proximity fuse during World War II, will direct and review Bureau programs, working through the Associate Directors for Engineering, Chemistry, the Boulder (Colorado) Laboratories, Planning, and Administration. He will continue to serve as Associate Director for Physics. A member of the Bureau staff since 1941, Dr. Huntoon has served in many positions conducting and supervising research in such fields as experimental nuclear physics, atomic physics, electronic ordnance devices, digital computers, and fundamental physical constants.

Albert A. Nelson will fill the position of commercial research manager of Emery Industries, Inc., Cincinnati, O. He will conduct market studies, sales analysis, and profit and pricing studies. Mr. Nelson is a member of the American Marketing Association and has had experience buying with the Proctor & Gamble Co. and in sales research with the Gibson Art Co.

Daniel J. Rowe has been named technical sales representative for the East Coast territory for Marbon Chemical, Washington, W. Va., a division of Borg-Warner Corp. Previously he was with Catalin Corp. of America selling styrene, polyethylene, and nylon to extruders and molders.



William Weston

William Weston has been elected vice president of operations, Ultra Chemical Works, Inc., a division of Witco Chemical Co., Inc., New York, N. Y., and will be responsible for manufacturing operations at all company plants. Main headquarters for detergent and chemical manufacturing are in Paterson, N. J.

W. S. Chinery has retired as vice president and technical director of Industrial Rubber Goods Co., St. Joseph, Mich.

James Steiner, assistant manager of A. Schulman, Inc., in the New York office, has been appointed sales manager of the Chicago, Ill., branch. This new branch office was recently opened at 2947-51 W. Touhy Ave., Chicago, Ill. It will better serve the growing demands of the Midwest for the company's products.

H. J. Mackin, district manager at New York, N. Y., for industrial products division of Goodyear Tire & Rubber Co., Akron, O., has been promoted to assistant manager, eastern region, with his office remaining in New York. **B. E. McClelland** has been moved up from assistant to manager of the New York district to fill the post vacated by Mr. Mackin, and **H. L. Jinkerson,** field representative at Cleveland, O., has been named assistant manager at New York. The move brings the Boston district office under the administrative wing of the New York regional manager, but the company said that it would not change operating policies at Boston or affect service. Mr. Mackin has been with Goodyear since 1915, with time out for military service, and was named New York district manager in 1939. Mr. McClelland has been with the company since 1949 and has served as assistant manager in Chicago prior to taking the same post in New York. Jinkerson also was named to field sales at Goodyear in 1949 at Memphis, Tenn., and to Cleveland in 1952.

Arthur F. Quinlan has been named assistant regional sales manager for Atlas Powder Co., Wilmington, Del., in the Chicago, Ill., chemicals sales office. Mr. Quinlan has been affiliated with Atlas since 1950, when he was graduated from Lafayette College. He has been serving in the New York, N. Y., sales office.

K. C. Free has been appointed vice president in charge of sales, and **W. J. Jordan** has been made vice president in charge of production for the Independant Die & Supply Co., St. Louis, Mo. Both men have had many years of service and experience with the firm, with Mr. Free having served for 20 years and Mr. Jordan for 28 years. The move was prompted by the need of keeping pace with demands of the industry, according to the company.

John H. Woelflein has been appointed technical sales representative for Vibrin polyester resins for the Naugatuck Chemical Division, United States Rubber Co., New York, N. Y. He will handle sales in the New England area and as far south as Philadelphia. He joined Naugatuck in 1950 in the process engineering department and for the past year was a senior chemical engineer in the Vibrin polyester development department.

John W. Pfeiffer has joined the export sales marketing staff of Amoco Chemicals Corp., Chicago, Ill. He holds a degree from the University of Warsaw, Poland, and a diploma from the Technological Institute, Freiberg, Germany. Previously he had been a product development director for American Cyanamid International.

Thomas A. Robertson has been named manager of tire engineering, and **Melvin P. Hershey** becomes manager of engineering for passenger, racing, and airplane tires and related products for the tire engineering and development department, The Firestone Tire & Rubber Co., Akron, O. Both have had wide experience in their fields. They joined the company's tire development department in 1941 and rose through the ranks to their present positions.

Frank A. Mather has been appointed a technical representative for Para-Chem, Inc., Philadelphia, Pa., in the sale of latex compounds for the textile, paper, and adhesives field. Mr. Mather has had seven years' experience in sales of latex, resins, and chemicals and is a member of several technical societies including American Association of Textile Chemists & Colorists, American Chemical Society, Philadelphia Rubber Group, and the Technical Association of the Pulp & Paper Industry.

Edwin O. Mills has been appointed technical representative for Glyco Chemicals Corp., New York, N. Y., an affiliate of Chas. L. Huisking & Co., Inc., New York. Mr. Mills will work out of the firm's Chicago office, covering northern Illinois, Minnesota, and Wisconsin.

Sam Salem

Sam Salem has been named general manager of the chemical division of The General Tire & Rubber Co., Akron, O. His appointment was made following the resignation of **A. L. Antonio,** who is returning to General Tire's rocket propulsion subsidiary, Aero jet-General Corp., Azusa, Calif., in an executive capacity. Antonio, one of the nation's foremost rocket engineers, took over General Tire's chemical division four years ago. Salem has been associated with the company since 1950.

Lewis W. Lubenow has been made field sales manager for the semi-bulk materials handling division of the Powell Pressed Steel Co., Youngstown, O. He has been active in both the materials handling and design engineering fields since 1939. Power Pressed Steel has since 1920 been a leading producer of all-steel materials handling containers, including pallets, platforms, box-platforms, and automatic handling systems.

Robert Coddington has joined Hartig Extruders, division of Midland-Ross Corp., Mountainside, N. J., as Midwest district sales manager. He will move to Mt. Prospect, Ill., as soon as the new Midland-Ross offices are ready there. He was formerly chief engineer for Johnson Rubber Co. and has also served other manufacturers in a development capacity.

William V. Miller has been appointed sales engineer, and **Cletus J. Brehme** has been appointed technical service engineer for the Girdler Catalysts Division of Chemetron Corp., Louisville, Ky. Both men were operating engineers with Chemetron's Girdler Construction Division. Miller joined Girdler in 1952, while Brehme started with the company in 1957.

Robert F. McClellan has been elected vice president of Nopco Chemical Co., Newark, N. J., and has been appointed general sales manager of the industrial division. He will supervise the sales activities of the division serving the tanning, paper, detergents, textiles, metal working, insecticides, and protective coatings industries. Mr. McClellan was formerly vice president of Nopco Chemical Canada, Ltd., and has been associated with Nopco for 31 years.

George S. Laaff has been appointed coordinator of product research and development for The General Tire & Rubber Co. plastics divisions. On a rotational basis, other plastics divisions' research managers subsequently will be appointed to this position. Laaff retains his present duties as manager of research and development at the Bolta Products division, Lawrence, Mass. In his new position he will coordinate product research and development at the four plastics divisions located at Cranston, R. I., Jeannette, Pa., Lawrence, Mass., and Toledo, O.

Roy D. Perdue has been appointed director of engineering for National Polychemicals, Inc., Wilmington, Mass., and **William M. Meeker** has been named technical sales representative for the firm, with headquarters at Wilmington. Mr. Perdue was formerly associated with the Army Ordnance Corps, serving in the Springfield Armory doing chemical engineering research. He has been a member of National Polychemicals engineering staff for the past 2½ years. Mr. Meeker was previously with Pequanoc Rubber Co. as a sales engineer.

Norman E. Bonn has been appointed director of research for Pyrometer Co. of America, Penndel, Pa. Mr. Bonn has specialized in the development of precision measuring techniques and apparatus and will direct the research effort in this line. He was formerly director of research for the Rubicon Instrument Co.

P. J. Wallace has been made plant manager of The General Tire & Rubber Co., Odessa, Tex. synthetic rubber plant. He was formerly production superintendent at Odessa and replaces **Jame A. Pollock,** who has been transferred to Akron, O., as a staff engineer in the chemical division. **Dwight Jeffrey,** general foreman at General's Mogadore, O., plant, succeeds Wallace as production superintendent at Odessa. Wallace started with General Tire in 1943 in the government-owned plant at Baytown, Tex. He was assigned to Odessa last April. Jeffrey joined General from Ohio State in the chemical division and was named general foreman at Mogadore in 1954.

(Continued on page 468)

NEWS from ABROAD

Malaya

Russian Buying Spurt Ups Rubber Prices

In the middle of October the price of rubber on the Singapore market topped 90 cents (Straits) a pound for the first time in 14 months, and with only a few slight dips, this level was maintained to the end of the month. The highest price at which rubber was sold here was 93 cents on October 21. The average price for the month was 87.92 cents a pound, 11½ cents above the average for the first half of 1958; the average in September had been 82.40 cents, and in October, 1957, it was 83.51 cents.

Prices began to show improvement around May and, although at the time most other commodities declined, continued to improve steadily almost entirely because of heavy buying by Russia and other Communist countries. The recent sharp increase again was chiefly caused by intensified Russian buying both in London and on the Singapore market, although better orders from America and European countries were also factors, and the shelling of Quemoy cannot be wholly discounted.

Russian rubber buying in Malaya for November shipment, originally estimated at 10,000 tons, then 15,000 tons, has most recently been put at more than 20,000 tons, and there are unconfirmed reports of her interest in No. 1 sheet for December shipment. Potential Russian purchases for the first 10 months of 1958 on the Singapore market have been put at 60,000 tons, which compares with 15,000 tons for all of 1957, 13,000 tons for 1956, and 3,500 tons for 1955. Shipping statistics show that a total of 20,918 tons went direct to the Soviet Union from Malaya in the first nine months of 1958; Singapore trade figures indicate that Russia bought 37,608 tons during that period.

Much speculation exists as to the reason for this sudden Soviet activity. In London there is reportedly a tendency to link these purchases with heavy Soviet sales of metals, including tin, aluminum, and platinum. It is believed there that Russia is nowhere near self-sufficient in rubber for her own needs and those of her European satellites, which appear to be urgent because of some special plans; and that in order to obtain the cash for rubber payments, she has unloaded excess supplies of commodities at cheap prices.

Interest in Indonesia

While Russia was such an important factor on the Singapore market during October, Communist China, which bought 25,000 tons of rubber from Malaya in July and a total of about 60,000 tons in the first nine months of 1958 (in her capacity as purchasing agent for Communist countries), has of late switched her attention to Indonesia, from which she has been taking large amounts of rubber, it is reported. At the same time it is learned that Indonesia, which has been having difficulty with rice supplies, has entered a three-way deal under which she will ship rubber and other products to Russia in exchange for 200,000 tons of rice which China will supply between October, 1958, and March, 1959; and China apparently settles with Russia for the rice.

On the heels of this news, come reports from Jakarta and Tokyo about a projected trade agreement to be negotiated by a Soviet mission in Jakarta and the Indonesian Government involving the sale to Russia of many thousands of tons of rubber—the exact amount is not revealed. This would be the first time Russia has bought rubber directly from Indonesia.

While Singapore may be feeling uneasy over the rubber/rice arrangement since rubber exports from Indonesia and rice imports into Indonesia have always passed through Singapore and have formed an important part of its entrepot trade, the Indonesia/Russian rubber business does not appear to be considered cause for concern by local rubber men. The tendency is to assume that with present inefficiency in estate and other rubber growing in Indonesia, that territory is not in a position to be able to sell very large amounts of rubber to China and Russia as well as to other consumers; so that the latter would have to go to Malaya for supplies otherwise bought from Indonesia. And once again the question as to the object of this heavy buying by Russia comes up.

Incidentally, Russia purchased 205 tons of rubber from Ceylon for direct shipment last August—another first—and further transactions are looked for.

New Planting Plans

More than a year ago the Rubber Traders' Association of Malaya urged that the government alienate up to 1.5 million acres of virgin jungle for planting high-yielding rubber within the following ten years. The Minister for Industry and Commerce, Tan Siew Sin, various estate companies, the then-chairman of the Rubber Producers' Council, all approved the idea, but nothing was done then.

Apparently the times have helped mature the idea, for the latest news from Malaya is that Mr. Tan is now himself pushing such a scheme. He has the support of Leong Hoe Yeng, present chairman of the Rubber Producers' Council, who is quite confident that Malaya could plant one million acres of jungle with rubber in ten years, and that by 1965 she would be producing two million tons a year as her contribution to the world's rubber needs, expected to be 4-5 million tons a year by then.

The chairman of Prang Besar Rubber Estate, Ltd., R. O. Jenkins, also is all for the plan. He is reported as referring to the prediction by the Goodyear research division of a large deficit in natural rubber by 1960, to increase thereafter, and pointing to the obligation this would impose on manufacturers to prepare to make up the difference with synthetic rubber. For these reasons he felt that the drive by the Minister of Commerce to hasten the extension of Malayan planted acreage deserved fullest support.

Rubber Research Push

Recently returned from his visit to Montreal to attend the Commonwealth trade talks held there, Tan Siew Sin, Minister for Commerce & Industry, stated that the rapid progress of synthetic rubber in the United States and Canada he had noted had considerably shaken him, and he earnestly warned of the need of spending "a lot more money" on rubber research if Malaya's rubber industry is to survive in the next 20 years. He quickly added, however, that there was no immediate danger to the industry here; at any rate, he intended to lay before the Cabinet a plan for suitable increase in rubber research.

Leaders of the industry here agree on the importance of continuing research to improve Malaya's competitive position; but, on the whole, producers are inclined to share the opinion of T. M. Walker, director of Guthrie & Co., Ltd., that while more funds will not be

denied if the necessity is shown, there is no merit in simply voting money. The object of first importance, Mr. Walker feels, is to reduce production costs of natural rubber, and it is on this that scientists are and must continue concentrating.

"The producers who have replanted with high-yielding grades," he reportedly told the press, "are well on the way to living on terms with synthetic."

The rubber research cess was raised not long ago to the present rate of ¾ cent (Straits) per pound of rubber exported, and expenditure on rubber research now comes to $10,500,000 (Straits) annually.

The consensus here appears to be that the question of further increase in the cess will depend on the recommendations of the newly appointed leader ("superman," as the local press puts it) of Malaya's research program.

New Research Head

The merits of 137 applicants, many from America and Germany, for the $40.000-$60,000-(Straits)-a-year post of Controller of Rubber Research in Malaya, had to be examined before a selection was finally made by a committee of four, including two representatives of the industry and two of the government. The position has gone to a leading British agricultural expert, 63-year-old Sir Geoffrey Fletcher Clay, who is expected to take up his duties at the beginning of 1959. He will coordinate the research work now in progress at the Rubber Research Institute, Natural Rubber Development Board, and the Rubber Producers' Council; he will also direct Malayan rubber publicity abroad.

Sir Geoffrey, who was educated at Edinburgh and Cambridge, has been agricultural adviser to the Secretary of State for Colonies. He served as deputy director of agriculture in Nigeria and Uganda just before World War II; in 1943 he visited Malaya. He was selected a member of the British delegation to the United Nations' conservation of resources conference and was joint leader of a UN mission to Korea to prepare a five-year plan to rehabilitate Korean agriculture, forestry and fisheries, in 1952-53.

Great Britain

RABRM on Skim Rubber

The increasing production of concentrated latex by centrifugation on plantations has put on the market large quantities of "skim" rubber made by coagulating the by-product skim latex. This rubber has a high content of non-rubber substances, as proteins, and shows undesirable properties when compounded in the normal way.

Discussions initiated by the tire manufacturers led the Research Association of British Rubber Manufacturers (RABRM) to institute investigations into the properties of skim rubber to find the best way of using it. Results of the work are reported by R. C. Moakes, S. H. Morrell and J. R. Pyne, in Research Memorandum No. R 410, issued by the Association.

Skim rubber from a number of estates as well as samples of skim rubber treated to reduce non-rubber content were examined. Treated skim rubbers proved less scorchy than the untreated samples and can probably be compounded like normal rubber. Most skim rubbers, including some of the treated types, give harder, stiffer vulcanizates than normal rubber. Untreated skim rubbers are extremely variable, also as regards aging, though none of the skim rubbers showed significantly bad aging.

An important finding was the relation to scorching of accelerator type used in compounding. Excessive scorching tendencies of untreated skim rubber were found in compounds made with acidic accelerators, but not in those containing basic accelerators. The latter tend to eliminate this defect and also to reduce variability between different samples of skim rubber. Scorchiness seems to be due to the quick-curing nature of the rubbers, and efforts to improve scorch time to a desirable extent by reducing acid accelerator content, only led to deterioration of physical properties of the vulcanizates.

The above observations suggested that blending skim rubber with SBR might be advantageous, in that thereby the scorching tendency of the former might be lessened, while the curing time of the latter might be cut. Encouraging results were obtained with blends of skim and SBR in resin-rubber compounds for shoe soling. But blends of oil-extended SBR and skim rubber, tested in flooring compounds, were not satisfactory, partly because of the SBR used. This point suggests that in suitably designed compounds skim could satisfactorily replace a standard grade of RSS as the NR component.

NR Ozone Resistance

"Ozone Resistance of Natural Rubber Vulcanizates," originally published in 1956 as a thesis by B. I. C. F. van Pul, of the Rubber Research Institute, T. N. O. Delft, has since appeared in three installments of the *Transactions of the Institution of the Rubber Industry*.[1]

Part I describes apparatus developed at the Delft Institute for evaluating the cracking resistance of rubber specimens exposed under static and dynamic conditions to ozone concentrations between 5 and 50 x 10^{-8} ml/ml of air. The device combines the principles of Crabtree and Kemp with some of the improvements suggested by Ford and Cooper, but it is intended for ozone testing only and not for weathering.

Part II discusses the influence of different grades of carbon blacks, white reinforcing fillers, and paraffin waxes. Ozone cracking resistance was determined for one time of cure, after a preliminary investigation had shown that differences in curing time have little effect. No appreciable differences were observed in cracking for black-loaded vulcanizates, despite differences in modulus.

The white fillers, unlike the carbon blacks, were found to give different levels of ozone resistance, although differences in moduli of white stocks were smaller than in the case of black-loaded stocks. Under dynamic conditions, Hakuenka[2] white filler gave the best results; under static conditions, particularly at 40° C., Siltegs[3] AS 5 and AS 7 gave the lowest ozone resistance.

Tests with various commercial waxes showed a reasonable correlation between protective power and physical and chemical properties, particularly melting point, refractive index, and number of side chains, of the waxes. None of the waxes, however, give ozone protection under dynamic conditions.

The influence of accelerators and antioxidants was reported in Part III. Of the accelerators investigated, the thiuram derivatives appear to give the best anti-oxidant effect when they are used as curing agents. Of the anti-oxidants, NN'-di-sec-octyl p-phenylene diamine appeared to give the best anti-ozonant effect, and vulcanizates prepared with it showed no cracks after exposure for 400 hours to ozone concentration of 25 x 10^{-8} ml/ml under static conditions.

[1] Vol. 34, Nos. 1, 2, 3 (1958).

[2] Calcium carbonate, Shiraishi Kogyo Kaisha, Ltd., Tokyo, Japan.

[3] Active white filler, Fullstoff Gesellschaft Marquart-Wesseling, G.m.b.H., Cologne, Germany.

Indonesia

The directors of 94 Dutch estate companies with property in Indonesia have sent telegrams strongly protesting the action of the Indonesian Government in taking over their enterprises, it is learned. They emphasized that the measures employed are in conflict with principles of international law and also violate principles laid down in the provisional constitution of the Republic of Indonesia; they deny the legality of the Indonesian action and call for the recognition of their rights.

(*Continued on page 468*)

NEW MATERIALS

Santicizer 409

A new, fast-blending polymeric plasticizer for permanent flexibility in a broad range of general-purpose polyvinyl chloride applications has been announced by Monsanto Chemical Co., St. Louis, Mo. Trade marked Santicizer 409, the new compound is described as highly resistant to extraction and migration, low in both odor and color, and highly compatible under humid conditions.

Chemically, Santicizer 409 is a polyester derived from adipic acid and has a molecular weight exceeding 2,000. It is the company's first polymeric plasticizer.

Santicizer 409's efficiency, electrical resistivity, and permanence under heat aging make it an ideal plasticizer for wire coating and film for electrical tape. Its permanence, low cost (39¢ per pound, tank-car quantities), and excellent compatibility should be of interest to manufacturers of general film and sheeting and coated cloth.

Some typical properties of Santicizer 409 follow (dibasic acid-glycol polyester):

Appearance	clear, viscous liquid
Acidity, meg./100 gms	0.6
Color, Gardner	1
Moisture, %	0.05
Odor	very faint ester
Pour point, °F	40
Refractive index, 25° C	1.4654
Specific gravity, 25/25° C	1.084
Viscosity, poises at 25° C	30
Efficiency factor	1.30
Pounds per gallon, 25° C	9.04

New Rubber Odorants

New patented odor-retentive compounds, said to impart fragrances with a life of two to five years to rubber formulations, are being marketed by Tyrex Drug & Chemical Corp., New York, N. Y. Described as saponified derivatives of natural essential perfume oils, the new compounds have the unique feature of combining a relatively low initial emission of the fragrance with an extraordinarily long fragrance life. This differs from the action of untreated essential oils, which often emit an objectionably strong initial odor, with the effect rapidly diminishing within a few days.

Used in rubber compounds, the new chemicals serve to mask any odor arising from the rubber itself, and simultaneously give off a lastingly pleasant aroma. The odorants, which are crystalline in structure and very light in color, are compatible with all materials used in rubber compounding. Incorporation in existing rubber formulations is accomplished by adding the proper proportions of the odor-retentive chemical; no change in production processes is involved. As furnished by the company, these chemicals are very light in color and soluble in alcohol and most organic solvents.

Tyrex is prepared to furnish, to interested manufacturers, test samples of some of the fragrances it has already compounded; on short notice, special test samples can be compounded to simulate any fragrance in which the prospective user may be interested. Any fragrance selected can be placed in volume production in a relatively short time. The Tyrex technical staff will work closely with rubber chemists in adapting the new materials to specific formulations.

Paracril ALT

Paracril ALT, a low acrylonitrile, low-temperature polymerized Paracril rubber, is now being offered by Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. It is intermediate in acrylonitrile content between Paracril AJ and Paracril B or BJ.

This new material was originally created for use in hose tubes for service at low temperature. Its use in such compounds allows safe processing, even though the compounded Mooney viscosity of such tubes must be high if the tubes are to be wire braided. It is compatible with all other Paracrils and can be used with Paracril BLT, BJLT, or CLT to obtain blends of low-temperature polymerized rubber containing a wide range of acrylonitrile.

Some typical raw polymer properties of Paracril ALT follow:

Physical form	bale
Acrylonitrile	medium low
Specific gravity	0.96
Mooney viscosity ML-4 @ 212° F.	80–90
Stabilizer	non-discoloring and non-staining
Solution properties	excellent
Processing properties	excellent

A technical data sheet, Bulletin No. 229, giving more detailed information and a laboratory study comparing Paracril ALT with AJ, B, and BJ as well as processing data, is available from the company.

MR-22 Mold Release

A new mold release, designated MR-22, is now available from Peninsular Silicones, Inc., Grand Rapids, Mich. The new material is a composite of selected silicone compounds dispersed in compatible organic solvents. It is applied for mold release as received without further alteration or extension and is heat curable (thermosetting). The resulting film is said to be a hard, durable, tightly adherent, flexible, and transparent continuous layer possessing extraordinary release properties.

Treatment of a mold with MR-22 yields a permanent release characteristic as opposed to many release agents which must be applied cyclically after each molding operation or every few molding cycles. MR-22 is recommended for spray application utilizing conventional spray equipment employed typically for modern decorative finishing operations. The mold to be processed receives a light spray coating of MR-22, after suitable surface preparation, and is allowed to air dry for 15-30 minutes. A curing operation follows immediately after air dry period.

It is reported that in factory trial results in the use of MR-22, as applied to tire molds, more than 1,000 heats were obtained before reapplication of MR-22 was needed. Also several hundred releases have been obtained in molding smaller rubber parts.

Elastex 36-R, 37-R

Two new polymeric plasticizers—characterized by their extreme durability as primary agents or in blends with monomeric-type plasticizers—have been developed by Plastics & Coal Chemicals division, Allied Chemical Corp., New York, N. Y. According to the company, the new, light-colored materials lend themselves to adaptations more readily than earlier polymeric types.

Elastex 36-R is a medium molecular weight general-purpose polyester plasticizer. When used as the sole plasticizing agent in vinyl calendering and extruding compounds, it provides the excellent durability and permanence of very high molecular weight polymerics while maintaining the superior handling and processing properties characteristic of the monomerics. In addition, 36-R is said to have outstanding ability to resist extraction by aliphatic and aromatic hydrocarbons. Nitrile elastomers compounded with 36-R Plasticizer find utility in oil-resistance uses.

Blends of Elastex 36-R with monomeric-type plasticizers such as DOP also exhibit good permanence, durability, oil and kerosene resistance, and handling properties.

Elastex 36-R is recommended for use in upholstery sheeting,

coated fabric, wall covering, electrical tape, high-temperature wire insulation, and window channeling.

Elastex 37-R, a high molecular weight polyester plasticizer, is specifically designed for vinyl compounding. Its outstanding permanence is demonstrated by retention of original properties by compounded vinyl resins exposed to high temperatures. No shrinkage occurs in vinyls plasticized with 37-R Plasticizer-DOP blends even upon severe heat aging.

Elastex 37-R Plasticizer also offers excellent resistance to extraction by kerosene, oil, and soapy water. Nitrile rubbers, as well as vinyls, compounded with 37-R Plasticizer exhibit good oil resistance.

The extreme durability under high-temperature conditions and superior compatibility of 37-R Plasticizer and DOP blends commend use of 37-R in cable jackets, paper coatings, refrigerator gaskets, high-temperature and high-humidity resistant insulation, and high-grade upholstery sheeting.

Some typical physical properties of Elastex 36-R and 37-R follow:

	36-R	37-R
Molecular weight	1,900	6,900
Appearance	clear yellow liquid	clear yellow liquid
Color, Hellige	5 max	3 max
Odor	mild, characteristic	mild, characteristic
Viscosity (Brookfield) @ 25° C., poises	38	2,700
Surface tension @ 25° C., dynes/cm	39.1	50.0
Specific gravity, 20/20 C.	1.09	1.15
Pounds per gallon at 68° C	9.12	9.59
Refractive index, N_D^{20}	1.466	1.475
Weight loss, 72 hr. @ 82° C., %	0.129	0.035
2 hr. @ 175° C., %	0.544	0.155
Flash point, Cleveland open cup, °F	545	575
Fire point, Cleveland open cup, °F	615	635
Water, wt., %	0.02	0.05
Acid number, mg KOH/g	8.20	8.54
Saponification number, mg KOH/g	518	597
Volume resistivity, ohm-cm	5.6×10^{10}	3.8×10^{11}

Technical data sheets, C-5827 and C-5828, describing Elastex 36-R and 37-R, respectively, are available from the company.

Fura-Tone NC 1008

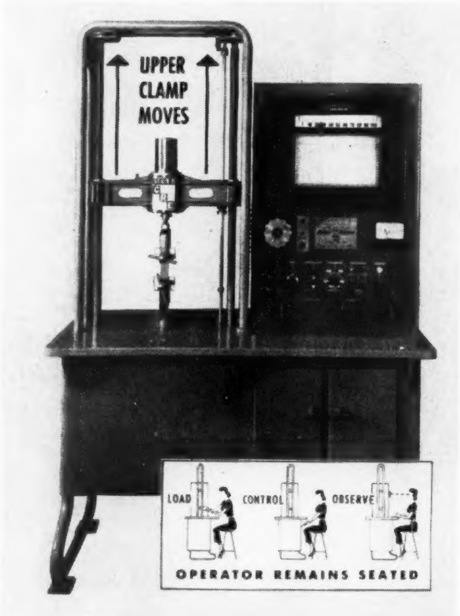
Fura-Tone NC 1008, a solid, thermoplastic, furfural-derived resin designed for use as processing aid and as an extender for synthetic rubbers, is being marketed by the Irvington chemical division, Minnesota Mining & Mfg. Co., Newark, N. J. Generally speaking, the addition of this dry resin has a desirable influence on elongation, hardness, and oil resistance. In neoprene, an increase in ozone resistance can be gained through the use of this material.

Some typical physical properties of Fura-Tone NC 1008 are:

Softening range	160–185° F. ball & ring
Odor	slightly aromatic
Specific gravity	1.25 at 25° C.
Color	dark brown
Solubility	soluble in ketone and aromatic solvents. Insoluble in aliphatic solvents

A technical data sheet, available from the company, gives a summary of the effects of NC 1008 on the properties of the vulcanizates of SBR (gum and black), nitrile (gum and black), and neoprene (black) rubbers.

NEW EQUIPMENT



Scott's new tensile tester

Scott CRE Tensile Tester

Scott Testers, Inc., Providence, R. I., has announced a completely new CRE tensile, elongation, stress-strain tester which for the first time makes ultra-precise electric weighing tensile evaluation available at moderate cost. The new Scott CRE Tester was displayed in operation at the October textile exhibitions in Manchester, England, and Greenville, S. C. This CRE tester can be used for stress-strain evaluation of all materials in the range of capacities from 0-0.05 to 0-1,000 pounds or 0-25 grams to 0-500 kilograms, held by any of the existing 150 types of Scott clamps and holding fixtures, in conformance with ASTM, ISO, and industry methods.

Constant extension of the specimen is accomplished on the tester by an upward moving crosshead attached directly to the load measuring unit which pulls the top holding clamp away from the lower fixed clamp at precisely uniform speed (adjustable from 0.05-inch to 20-in./min.) to a length up to 70 inches of crosshead travel. Stroke of crosshead travel may be specified at the time of purchase as one of six ranges, 20, 30, 40, 50, 60, and 70 inches.

The stress-strain curve is charted on a visual recorder. Ratio of chart travel to crosshead travel may be varied to magnify curve as much as 400:1, permitting minute analysis.

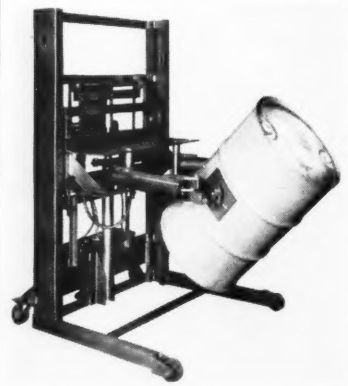
The tester is a single self-contained unit. It is free standing with levelizer feet and requires only a single 110-volt supply connection. Some of the optional features available are: two-speed drive including selector buttons; variable speed drive including tachometer and infinite speed selector wheel; or infinite-range variable speed drive including tachometer, hi-low range control, and speed selector wheel which will give the ultimate in flexibility of testing.

New Equipment

Other optional features are: range control selector, which gives control of recorder span from 100% of rated capacity through 50%, 20%, 10% down to 5% of rated capacity; a time-to-break indicator, timing device and indicating light to allow operator to establish and follow a schedule; an elastomer pipping circuit with control button; force dividers in a wide range of capacities which are mechanically interchangeable in the load cell; and a change of recorder speed ratio.

An illustrated six-page CRE tester brochure is offered by Scott Testers, Inc.

Colson Dumping Lifter



Portable drum dumping lifter

A portable dumping lifter that promises widespread application in handling of drums and other cylindrical objects has been introduced by special products division, The Colson Corp., Somerville, Mass. With 360-degree rotation and 90-degree tilt, this unit is designed to solve problems in handling of drums in the rubber industry.

This model, according to the firm, can grab, lift and dump drums up to 55-gallon capacity and will lift rolls of up to 1,000 pounds. It is especially suited for unloading from trucks and double- and triple-decking storage. This lifter, moreover, will carry objects to processing, dump their contents, and return container to storage for other disposition.

The unit has two separate hydraulic systems. Lifting is battery operated, with hand operation for clamping. Arm spreads are 18 to 38 inches in diameter, but the company will produce other spreads.

Clamps will operate to within six inches of the floor. Lifting speed is 15 feet per minute, with total lift of 52 inches. Grab shoes are rubber-lined to assure that smooth surfaces will not be damaged, states the manufacturer.

New Sub-Zero Cabinet

The American Instrument Co., Inc., Silver Spring, Md., is offering a newly modified, dry-ice operated Sub-Zero cabinet with a temperature range of 200 down to —120° F. The new Sub-Zero incorporates a large-size testing cabinet in which materials and/or instruments may be tested under controlled temperature conditions. It can be used as a storage cabinet for perishable items or as a unit for accelerated aging tests.

The cabinet is divided into two sections, a testing chamber located on one end; a dry-ice compartment on the other. The lid is fitted with a five-ply Thermopane window for observing samples under test. A thermostatically controlled blower, mounted in the dry-ice compartment, forces CO_2 into the working chamber as cooling is required. Uniform air circulation is assured by a fan.

Two sizes of Sub-Zero cabinets are offered, one with a dry-ice capacity of 60 pounds (work space dimensions: 24 by 24 by 24 inches); the other with a 50-pound dry-ice capacity (18 by 16 by 20 inches). Cabinets are made with plywood exteriors and galvanized steel interiors, separated by thick layers of high-grade insulation.

The Sub-Zero is fitted with a control unit incorporating the necessary switches and pilot lights to indicate thermoregulator operation. Constancy within the unit varies from ± ½° at

(*Continued on page* 458)

Stacking up profits is easier... when you use Ameripol Rubber

Before: *Ordinary bags have to be unloaded from truck or rail car one by one—takes extra time and manpower, increases costs.*

After: *Ameripol comes in bags with vertical-release glue to permit easy, safe stacking, economical lift truck handling.*

PROFITS go up, handling costs go down when your plant gets Ameripol rubber in bags that can be safely pallet-loaded. As many as 28 bales of rubber may be loaded on a single pallet. Yet when it's time to unload, each bale can be lifted off without damage to the bags.

Improving packaging to cut handling costs is part of the Goodrich-Gulf program to make rubber processing easier and less costly. It includes new product developments to cut your costs. It includes addition of new manufacturing facilities to put vast supplies of raw rubber nearer to you. These are all reasons Ameripol has become—*the preferred rubber*...examples of how your company can profit when you buy from Goodrich-Gulf Chemicals, Inc., 3121 Euclid Avenue, Cleveland 15, Ohio.

Ameripol
THE PREFERRED RUBBER

Goodrich-Gulf Chemicals, Inc.

NEW PRODUCTS

New Restyled Battery

BFG Restyled Battery

B. F. Goodrich Tire Co., Akron, O., recently introduced a new line of 12- and six-volt batteries whose containers have been restyled and colorfully decorated. The new batteries have three textured panels on the front side that resemble battery plate grids. The panels give the batteries a vertical motif and also point up the function of the batteries. One of the three panels is painted a contrasting color from the dominant hue.

The company's premium battery, named Silvertown, is finished in bright blue, white, and red, with the blue dominant and one panel in white. The Pow-R-Pak, an original-equipment-type battery, is black, red, and white, with the black dominant and one panel in red. A third battery, named Electro-Pak, is in two colors, red and black. Acid-resistant paint is used on the hard rubber containers in all three lines.

The three lines have been consolidated into fewer types to simplify inventory and investment for dealers. The line, however, has a battery to fit all American cars and many foreign cars.

The new batteries will be available in both wet and dry charge. They incorporate latest development in grid metal and plate materials for resistance to the harmful effects of overcharge. A specially refined acid resistant sealant is used with all covers. The sealant forms acid-type joints between covers and container, helping to resist flow at high summer temperatures and cracking at low winter temperatures.

All three grades of batteries have Quick-Glance Fill Control, which enables servicemen to tell at a glance when the battery needs water. It also helps to prevent overfilling.

New Naugaweave Fabric

United States Rubber Co., New York, N. Y., has introduced a new line of upholstery with attractive vinyl designs anchored to soft woven fabric. The new upholstery, called Pace, features a non-repeat random vinyl design on fabric, with a silver print accenting the random pattern. It has a woven look, is porous, soft and comfortable in feel, easy to tailor, yet can be cleaned with a damp cloth.

Pace is an addition to the company's Naugaweave line, which

Pace upholstery fabric

was formerly called Breathable Naugahyde. It is being introduced in 10 colors which supplement the colors in the company's geometric Trend pattern of Naugaweave, brought out last April.

Pace and Trend are made with a new manufacturing process, in which a soft woven fabric is reinforced with a special protective vinyl coating that gives color fastness and resistance to soiling. The modern random vinyl pattern in Pace is then permanently fused to the fabric with silver print as an accent. It gives manufacturers and decorators an upholstery that is durable, breathable, and supple, it is further claimed. It is both decorative and practical for furniture in the home, hotels, motels, and other traffic spots.

Pace's ten colors are tangerine, sandalwood, green olive, shadow gray, antique white, sand, mustard, ginger, espresso, and cerulean. The new upholstery is 54 inches wide and will be sold in 30-yard rolls, through distributors and direct to volume furniture manufacturers. It is made in the company's Stoughton, Wis., plant.

Goodyear Racing Tires

The Goodyear Tire & Rubber Co., Akron, O., is marketing a full line of racing tires for stock-car use which include the Blue Streak Special for use on high-speed asphalt and hard surface tracks; All-Weather Speedway for asphalt and dirt tracks; and All-Weather Raceway for dirt and loose surface tracks. All tires, made with 3-T nylon cord, feature an exclusive round contour profile and special heat-resistant compounds.

In the Goodyear racing tire, with tapered shoulder and wider outer rib, cornering pressures are spread over a wider tread area. This round contour profile is said to cut down extreme wear in the outer rib area.

The two compounds developed for racing tire use—"G" for multi-lap and long track races, and "R" for medium-speed races on short tracks where exceptional traction is required—contain special agents to withstand the effect of heat, chief cause of tire separation and porosity.

Blue Streak Special tires are available in the following sizes: 7.50/8.00-14, 8.50/9.00-14, 6.50/6.70-15, 7.10/7.60-15, and 8.00/8.20-15. The All-Weather Raceway and All-Weather Speedway tires are produced in 7.10/7.60-15 sizes. Special heavy-duty racing tubes are available for all tires.

Goodyear maintains headquarters, warehousing and shipping facilities for its racing tires in Dayton, O.

Sub-Zero Cabinet

(Continued from page 456)

—100° F. to ± 1° at 200° F.

Low temperatures are obtained quickly. Starting at room temperature, the time required to reach —100° F. is approximately 90 minutes. After reaching —100° F., and operating under average conditions, the cabinet uses 2-2½ pounds of dry-ice per hour to maintain this temperature.

Complete information is contained in Aminco's new Constant-Temperature Catalog 500, available from the company.

Rubber parts courtesy of Brown Rubber Co., Inc.

TECHNICAL BOOKS

BOOK REVIEWS

"Applied Mathematics for Engineers and Physicists." Second Edition. Louis A. Pipes. Cloth cover, 6¾₁₆ by 9¼ inches, 723 pages. McGraw-Hill Book Co., Inc., New York, N. Y. Price $8.75.

The first edition of this book was published in 1946 and met with considerable approval because it brought under one cover a large mass of mathematical techniques set forth in a remarkably clear manner. While it is true that most of these topics were not developed too deeply, there was sufficient emphasis on rigor to satisfy the average reader, and almost every topic was introduced by at least one example which brought out clearly why it should be of interest to the applied scientist. For those who wished to pursue a particular subject further, the author followed each chapter with several references.

In this revised edition the author has retained most of his original material. The book covers several of the topics usually associated with advanced calculus such as infinite series, partial differentiation, and gamma functions. A large proportion of the book is devoted to differential equations, difference equations, Bessel functions and Legendre polynomials, and partial differential equations. There is a fairly comprehensive treatment of the theory of matrices and its application to linear systems, and an adequate treatment of the Laplace and associated transforms.

The chapter on non-linear differential equations has been revised and expanded.

There are good chapters on vector analysis and functions of a complex variable. Fourier series and analysis, however, have been given a surprisingly light treatment.

It seems to this reviewer that today's applied scientist, faced as he is with ever-increasing demands upon his ingenuity to formulate into mathematical language extremely complex physical phenomena, must at times be inclined literally to throw up his hands in complete despair. For coupled with the greater complexity of his problems, he must of necessity deal with a great mass of mathematical techniques which have come into vogue since the energizing crisis of World War II.

This book is recommended to all engineers and other scientists who feel the need of an adequate, up-to-date mathematical reference work.

H. M. NAHIKIAN

"Applied Statistics for Engineers." By William Volk. Cloth cover, 6⅜ by 9¼ inches, 354 pages. McGraw-Hill Book Co., Inc., New York, N. Y. Price $9.50.

This book is one of the McGraw-Hill series in chemical engineering and, according to the author's preface, "is the outgrowth of a course entitled 'Applicàtion of Statistics to Chemical Engineering Data,' inaugurated at the Polytechnic Institute of Brooklyn in 1951 in the Graduate Division and under the Chemical Engineering Department."

Chapter headings are: Chapter 1, Probability; Chapter 2, Permutations and Combinations; Chapter 3, Distributions; Chapter 4, Measures of Variability; Chapter 5, χ^2, Chi Squared; Chapter 6, The t Test; Chapter 7, Analysis of Variance; Chapter 8, Correlation-Regression; Chapter 9, Sequential Analysis; Chapter 10, Nonparametric Statistics.

Chapter 5, χ^2, introduces the reader to the idea of hypotheses testing, but does not develop the concept of alternative hypotheses. The usual chi-square calculations are illustrated for 2 x 2, 1 x n, and r x c tables as well as for estimating "goodness of fit." In discussing limitations of the χ^2 test, the author states that one should not apply the test to classes of data in which the expected value is less than 5. More recent research has indicated that a lower value of 3 may be used without invalidating the test.

The uses of the t test, Type I and Type II erorrs, and the power of a test are discussed in Chapter 6. When, however, the test of the difference between two means is described, the estimated variances are assumed to be equal, and the reader is not made aware of any of the approximate t tests for the case of unequal variances. A nice feature of this section is the inclusion of Sillitto's tables for determining the minimum number of tests required to detect a specified difference between two means (or a mean and a fixed constant) with specified Type I and Type II errors.

Chapter 7 is concerned with the methodology of the analysis of variance (ANOVA). The use of the F-test for determining the homogeneity of two variances is illustrated, and Snedecor's F-tables are included in this chapter. Bartlet's test for the homogeneity of k variances is next discussed, but no mention is made of the fact that this is not a "robust" test; hence small deviations from normality limit the usefulness of the test. The ANOVA for single-factor, two-factor, hierarchical and factorial classifications are illustrated. Considerable space is devoted to the interpretation of the ANOVA calculations in terms of the fixed-effect, random-effect, and mixed models.

The problem of the comparison of k means in an ANOVA situation is noted, and Tukey's procedure, using a "wholly significant difference" (WSD) as a test criterion is described. Unfortunately Tukey's earlier procedure for separating a series of means into two or more groups, supposed to be different from one another, is also discussed. This procedure involves repeated tests of significance and is not considered to be on a sound basis.

Chapter 8 is devoted to correlation and regression analysis. Here the usual topics (simple regression, multiple regression, curvilinear regression, confidence statements on coefficients, etc.) are covered, including Fisher's method of obtaining orthogonal polynomials.

Nonparametric statistics, including Spearman's rank correlation, Wilcoxon's signed rank tests, Olmstead and Tukey's corner test for association between two variables, and Dixon's procedure for testing for "outliers", are important features of the final chapter.

NEW PUBLICATIONS

"Dispersion and Resistivity with Conductive Furnace Blacks." No. GD-22. Godfrey L. Cabot, Inc., Cambridge, Mass. By B. B. Boonstra and T. D. Bolt. 7 pages. The electrical resistivity of an SBR 1500 compound containing conductive furnace blacks has been studied to show the effect of extremely short mixing times and of the number of remills. It was found that maximum conductivity is achieved under conditions of very poor dispersion of conductive furnace blacks in rubber.

"Quality Control—A Company's Conscience at Work." Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Co., New York, N. Y. 20 pages. This brochure gives the outline in words and pictures of the company's operations in quality control from basic materials through the final manufacturing and packaging steps. The full color and black and white pictures along with the text describe the activities in the company's Kingsport, Tenn., Longview, Tex., plants where Tenite plastics, Butyrate, propionate, acetate, and polyethylene, are manufactured.

"The Richardson Select-O-Weigh with PCR (Punched Card Reader) Control." NP-2. The Richardson Scale Co., Clifton, N. J. 2 pages. This bulletin tells how prepunched cards eliminate manual settings for each blending formula or operation. Related benefits such as formulation privacy, continuous operation from any card, and simplified record-keeping are also discussed. Three photographs illustrate the bulletin and show details of a typical punched card, a Punched Card Reader, and a control panel.

Technical Books

Publications of the elastomer chemicals department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.:

"Hypalon Cellular Rubber." BL-342. By H. H. Klever and R. W. Bedwell. 4 pages. Cellular rubber products with their thin wall sections and large surface areas are particularly vulnerable to oxidation, ozone, sunlight, weathering, and chemical attack. This report gives various formulations of Hypalon 20 and explains its resistance to degradation from these causes.

"A New Method for Spraying Neoprene Maintenance Coatings." BL-343. By E. E. Kenyon and S. W. Schmitt. 4 pages. Neoprene maintenance coatings are tough, weather well, and protect metal from attack by many corrosive materials. A new system has been developed for spraying neoprene coatings of higher solids content than heretofore possible. This results in films that are up to four times thicker per spray pass. This report describes the new spray system, and gives a typical formulation.

"Solubility of Du Pont Accelerators and Antioxidants." BL-344. By R. W. Bell. 2 pages. Solubility data for accelerators and antioxidants are of interest to rubber manufacturers working with solution coatings, cements, or laminated articles involving solvent wipes. In recent years, new classes of solvents such as tetrahydrofuran, and dimethyl formamide have gained acceptance for special uses. This report summarizes the solubility of Du Pont accelerators and antioxidants in a variety of solvents.

"Huber Water Fractionated Clays for the Rubber Industry." J. M. Huber Corp., New York, N. Y. 12 pages. This booklet presents comparison of the several grades of clay furnished by the company and gives typical properties of Polyfil C, Polyfil X, Polyfil XB, Polyfil F, and Polyfil FB in formulations based on SBR, neoprene, and smoked sheets.

"B. F. Goodrich Food Industry Hose." B. F. Goodrich Industrial Products Co., Akron, O. 2 pages. This new data sheet on Goodrich food industry hose illustrates and describes hose recommended for conducting hot or cold liquids where taste or aroma must not be affected or where fruit juices or other beverages with high acid content must be handled. Extra-smooth hose tube has no pits to catch bacteria or to prevent thorough cleaning. Specifications and recommendations are provided.

"Okocord Flexible Cords and Portable Cables." Bulletin 1108. The Okonite Co., Passaic, N. J. 64 pages. This new manual, combining technical information and a catalog of flexible cords and portable cables, deals completely with the company's mold-cured Okoprene (neoprene) sheathed cords and cables. Its main divisions give dimensional data, engineering information, and splicing and terminating instructions.

"The Arkansas Encyclopedia." Arkansas Industrial Development Commission, State Capitol, Little Rock, Ark. 500 pages. This four-volume reference book includes the 87-page "Economic Atlas of Arkansas," the 222-page "Directory of Arkansas Industries," and the 100-page "Photographic Essay of Arkansas." The fourth volume, "An Economic History of Arkansas" in 60 pages, will be published soon. Designed to serve as a reference tool, especially for those executives concerned with plant location, the Encyclopedia will most likely have its greatest use to the state in the field of industrial development. Sales executives and others concerned with the economic potential of Arkansas will also find much material of interest, while it will go on public sale for $25.00, industrial executives may obtain a free copy by writing to the AIDC.

"Your Most Important Raw Material." American Society for Testing Materials, Philadelphia, Pa. By Everett P. Partridge. 27 pages. $1.25. This in an Edgar Marburg Lecture presented by Dr. Partridge at the 1957 annual meeting of the ASTM. He discusses the importance of industrial water to our national well being. The economics of our present and future industrial water situation is covered in this well-illustrated paper.

Publications of Harwick Standard Chemical Co., Akron, O.:

"Thixon Summary." Bulletin #03-1-7-8-58 is a complete rundown of the various grades of Thixon bonding cements and primers. The products are listed with a brief description and an explanation of each designation. Thixon products are manufactured by Dayton Chemicals Product Laboratories, Inc., and are used for the adhesion of rubber and rubber-like materials to metal.

"Butyl Oleate Technical." #06-59-2-9-58. This bulletin gives the description, chemical composition, specifications, properties, and recommended uses for this low-temperature plasticizer. Several changes have been made in the specifications since the previous bulletin.

Publications of Goodyear Tire & Rubber Co., Chemical division, Akron, O. (Tech-Book Facts):

"Wing-Stay 100 Discoloring-Type Stabilizer — Antioxidant-Antiozonant." Types and Properties 58-265. 9 pages. This bulletin describes the properties, uses, and typical test results of this new rubber chemical. It is described by the company as a mixed diaryl-p-phenylene diamine and is furnished as a flaked, blue-brown solid. The test results include some for use as a stabilizer in the production of the SBR-type rubbers as well as adding the Wing-stay 100 to dry rubber batches for antioxidant and antiozonant protection. Pictures and data show the resistance given to protected stocks and gums for aging of hot, cold, and oil-extended polymers.

"Pliovic S70—Modifying Resin for Easy-Calendering Vinyl Films." No. 58-115. 2 pages. Pliovic S70, a medium molecular weight, general-purpose vinyl resin, is said to impart easy fluxing and rapid flow to all types of vinyl compounds. Typical Pliovic resin properties, improved processing characteristics, film test compound formulation, and physical properties of the test compounds in tabular form are included in this sheet.

"Impact Resistance of Butyl-Modified Hard Rubber Compounds." Bulletin 201. Thiokol Chemical Corp., Trenton, N. J. 12 pages. The purpose of this study was to evaluate the use of butyl rubber in hard rubber compounding as an aid in obtaining improved impact resistance. An introduction, summary, test procedure, conclusions, materials used, and plots depicting the results obtained are included in the booklet.

"Fuller Equipment for the Process Industries." Bulletin G-3B. Fuller Co., Catasauga, Pa. 12 pages. This two-color bulletin describes the firm's equipment for the process industries. It discusses applications and performance characteristics of Fuller-Kinyon pumps, Airveyor pneumatic conveyors, Fuller-Huron Airslide fluidizing conveyors, rotary compressors and vacuum pumps, horizontal-grate coolers, Humboldt suspension-type preheaters, Lehigh inducted draft fans and hot gas washers, and Sutorbilt positive pressure blowers and gas pumps. Thirty photographs, seven drawings, 12 schematic illustrations, and eight tables of dimensions and capacities supplement the text material. Fuller is a subsidiary of General American Transportation Corp.

"Shaft-Mounted Speed Reducers." Book 2618. Link-Belt Co., Chicago, Ill. 24 pages. This booklet, describing the company's shaft-mounted speed reducers, contains engineering and selection information on: single reduction drives in six sizes, with nominal ratios of 5:1 and capacities up to 50 hp.; and double reduction drives in seven sizes, with nominal ratios of 15:1 and up to 40 hp. The new drives can be mounted at angular as well as horizontal positions by using either tie rod or foot mountings.

"Reliance V*S Drives." Bulletin D-2506. Reliance Electric & Engineering Co., Cleveland, O. 16 pages. This booklet describes the firm's V*S Drives, which provide precise, adjustable machine speeds from in-plant a-c circuits. The booklet illustrates in brief copy and full-color photographs and diagrams how V*S Drives operate and may be applied to various types of machinery. The manufacture and functions of the drive components, including regulators, exciters, motor-generator sets, operator's panels, and Super T motors are graphically covered. The bulletin also lists condensed drive specifications, dimensions, and accessories.

MARKET REVIEWS

Synthetic Rubber

New rubber consumption for the third quarter of this year was estimated at 364,100 long tons at the annual meeting of the Rubber Manufacturers Association in November. Synthetic rubber at the prevailing 65% of total being consumed in this country would therefore be used to the extent of 236,665 tons during this period. It was also estimated that new rubber consumption in this country in 1959 would amount to 1.5 million tons, which would mean 975,000 tons of synthetic at the 65% of total figure. The U.S.A. expects to export at least 200,000 tons in 1959 so that 1959 should be a good year for synthetic rubber producers.

Consumption of new rubber in October in the U.S.A. rose to 136,674 tons, a 10.9% increase over September usage; 87,988 tons were synthetic rubber. Consumption of synthetic in November and December will amount to about 74,000 tons, based on the October figure, if the above estimate of 236,665 tons for the last quarter proves correct. This consumption pattern for the last three months of the year follows quite closely that for previous years.

Consumption of synthetic rubber by types in October, as compared to September figures in long tons, was as follows: SBR, 73,044, against 64,860; neoprene, 7,209, against 6,405; butyl, 5,056, against 4,725; nitrile, 2,679, against 2,471.

Synthetic rubber exports increased in October to 13,200 tons from the September figure of 8,802 tons. A rise of about 4,400 tons of SBR and 1,000 tons of butyl was the major contributing factor.

The trend of developments in new types and prices for synthetic rubbers, particularly SBR, is difficult to determine because of lack of complete information on these subjects from the producers. An appeal is made on the editorial page of this issue to SBR producers to furnish such information, insofar as possible, in order that RUBBER WORLD may be more helpful in this connection to producer and consumer alike.

Natural Rubber

During the October 16-November 15 period the natural rubber situation improved considerably; on a world-wide basis it is going to come very close to selling its entire production of 1.9 million tons. As far as the United States is concerned, the automobile industry has also improved, and it becomes increasingly likely that rubber consumption in the United States in the fourth quarter of 1958 will be higher than estimated only a few months ago (364,100 long tons, according to K. O. Nygaard, B. F. Goodrich Co., at the November 20 annual meeting of The Rubber Manufacturers Association, Inc.).

Natural rubber seems to have reached a stabilization point of about one-third of the American market that is unlikely to change radically at any point in the near future. Natural rubber usage here has stabilized at about 35%.

October sales, on the New York Commodity Exchange, amounted to 11,350 tons, compared with 7,680 tons for September contract. There were 22 trading days in October, and 20 during the October 16-November 15 period.

On the physical market, RSS #1, according to the Rubber Trade Association of New York, averaged 31.64¢ per pound for the October 16-November 15 period. Average October sellers' prices for representative grades were: RSS #3, 30.00¢; #3 Amber Blankets, 25.97¢; and Flat Bark, 21.34¢.

Latex

During the October 16-November 15 period the liquid latex market remained fairly steady, and a somewhat better offtake was reported. Sellers are no longer prepared to accept any price just to relieve their stock position, and this attitude has resulted in a slight improvement in the differential for nearby latex and a more substantial one for the forward positions.

Consumption here continues to improve, and 6,897 tons were consumed in September; while stocks fell to 12,193 tons at the end of that month. These figures are the highest and lowest, respectively, since October, 1957.

Prices for ASTM Centrifuged Concentrated natural latex, in tank-car quantities, f.o.b., rail tank car ran about 41.03¢ per pound solids. Synthetic latices prices were 21.5 to 38.2¢ for SBR; 37 to 53¢ for neoprene; and 46 to 60¢ per pound for the nitrile types.

Final August and preliminary September domestic figures for all latices were reported by the United States Department of Commerce as given in the tabulation below:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Aug.	0	*	6,094	13,750
Sept.	0	*	6,748	12,482
SBR				
Aug.	5,474	—	4,654	7,166
Sept.	6,165	—	5,779	6,842
Neoprene				
Aug.	892	0	764	1,195
Sept.	1,075	0	820	1,354
Nitrile				
Aug.	1,103	0	1,025	2,049
Sept.	1,173	0	1,017	2,096

* Not available yet for period covered.

Scrap Rubber

During the October 16-November 15 period there was little change in the scrap rubber market situation. A fair

REX CONTRACT

1958	Oct. 17	Oct. 24	Oct. 31	Nov. 7	Nov. 14
Nov.	31.35	31.25	31.35	32.00	32.85
1959					
Jan.	31.05	31.00	31.00	31.65	32.00
Mar.	31.02	30.85	31.05	31.50	31.84
May	31.02	30.75	31.00	31.35	31.74
July	31.04	30.70	30.95	31.30	31.65
Sept.	30.95	30.65	30.95	31.25	31.60
Nov.	30.90	30.60	30.95	31.25	31.55

NEW YORK OUTSIDE MARKET

	Oct. 17	Oct. 24	Oct. 31	Nov. 7	Nov. 14
RSS #1	31.38	31.38	31.38	31.75	32.25
#2	30.88	30.88	30.88	31.38	31.88
#3	30.25	30.38	30.50	31.13	31.50
Pale Crepe					
#1 Thick	33.00	33.75	33.75	34.00	34.00
Thin	34.00	34.00	34.00	34.25	34.25
#3 Amber Blankets	26.50	26.25	26.25	26.50	27.00
Thin Brown Crepe	26.25	26.13	26.13	26.38	26.63
Standard Bark Flat	21.88	21.75	22.25	22.50	22.88

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Market Reviews

amount of activity continued to be noted, with most consumers acquiring scrap rubber stocks on a fairly regular basis.

Prices were unchanged from previously quoted levels.

	Eastern Points	Akron, O.
	Per Net Ton	
Mixed auto tires	$11.00	$12.00
S. A. G. truck tires	nom.	15.50
Peeling, No. 1	nom.	23.00
2	nom.	20.00
3	nom.	15.50
Tire buffings	nom.	nom.
	(¢ per Lb.)	
Auto tubes, mixed	2.75	2.75
Black	5.75	5.75
Red	6.25	6.25
Butyl	3.50	4.00

Reclaimed Rubber

There was a period of inactivity in the automotive industry during the period under review (October 15—November 15) which was reflected in the consumption of reclaim by original-equipment tire manufacturers. A swing upward is expected, however, during this month. Reclaim consumption by replacement tire manufacturers and other suppliers to the automotive industry remains stable, according to one source.

The use of butyl reclaim has increased in recent months, owing to the tire industry's use of this material in butyl interliners for tubeless tires.

Despite the strong fourth quarter anticipated by the reclaimers, total sales are not expected to exceed the 268,088 long tons which were consumed in 1957.

Another source reported that during this period reclaim business has been the best since about a year ago, and it is expected to continue good in view of the increased automotive production now getting under way.

According to The Rubber Manufacturers Association, Inc., report, October production of reclaimed rubber reached 26,800 tons, while consumption was 23,500 long tons.

Reclaimed rubber prices were unchanged during this period.

RECLAIMED RUBBER PRICES

Whole tire, first line	$0.11
Third line	.1025
Inner tube, black	.16
Red	.21
Butyl	.14
Light carcass	.22
Mechanical, light-colored, medium gravity	.155
Black, medium gravity	.085

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity, at special prices.

Rayon and Nylon

Production of all types of tire cord and tire fabric during the third quarter 1958 was 91,984,000 pounds, 14% above the previous quarter, but 7% below the third-quarter 1957 level.

The output of rayon tire cord and tire cord fabric increased 23% from the previous quarter's level to 59,081,000 pounds. During the same period, production of nylon tire cord and tire cord fabric increased 5% to 23,638,000 pounds.

Stocks of tire cord and tire cord fabric (including cotton) on September 27 were 37,657,000 pounds, or less than 1% above the June 28, 1958, level, but 24% less than the stocks for September 28, 1957.

A leading tire cord manufacturer has reported the following. Nylon cord tires are used exclusively on all commercial and military aircraft. All racers participating in the Indianapolis 500-mile speedway for the past five years have used nylon cord exclusively. A consumer testing organization, after a series of tests, stated that considering the only slightly higher cost of nylon in most brands, the extra safety factor they afford merits for nylon tires first consideration by the motorist.

Regarding the disposition of Tyrex, according to this manufacturer, American Society for Testing Materials' Committee D-13 on Textiles indicates that it cannot accept this type of high-tenacity rayon as a brand name; nor will the producers marketing this cord accept Tyrex in an uncapitalized, generic form. Thus the cord will probably be included under a rayon or cellulosic category at the next meeting of ASTM D-13 in March.

Total packaged production of rayon and acetate filament yarn during October was 57,300,000 pounds, consisting of 24,100,000 pounds of high-tenacity rayon yarn and 33,200,000 pounds of regular-tenacity rayon yarn. For September production had been: total, 56,400,000 pounds, including regular-tenacity rayon yarn, 33,300,000 pounds; high-tenacity rayon yarn, 23,100,000 pounds.

Filament yarn shipments to domestic consumers for October totaled 57,600,000 pounds, of which 23,900,000 pounds were high-tenacity rayon yarn, and 33,700,000 pounds were regular-tenacity rayon yarn. September shipments had been: total, 55,200,000 pounds; high-tenacity, 23,200,000 pounds; regular-tenacity, 32,000,000 pounds.

Stocks on October 31 totaled 59,100,000 pounds, made up of 13,400,000 pounds of high-tenacity rayon yarn and 45,700,000 pounds of regular-tenacity rayon yarn. End-of-September stocks had been: total, 60,600,000 pounds; high-tenacity rayon yarn, 13,500,000 pounds; regular-tenacity rayon yarn, 47,100,000 pounds.

No changes were made in rayon and nylon prices since the last report.

RAYON PRICES

Tire Fabrics

1100/490/2	$0.71 /$0.75
1650/908/2	.63 / .725
2200/980/2	.625/ .655

Tire Yarns

High-Tenacity	
1100/ 490, 980	.50/ .64
1100/ 490	.59/ .63
1150/ 490, 980	.59/ .63
1165/ 480	.59/ .65
1230/ 490	.59/ .63
1650/ 720	.55/ .58
1650/ 980	.55/ .58
1875/ 980	.55/ .58
2200/ 960	.54/ .57
2200/ 980	.54/ .57
2200/1466	.64
4400/2934	.60
Super-High Tenacity	
1650/ 720	.665
1900/ 720	.58

NYLON PRICES

Tire Yarns

840/ 140	$1.10/$1.20
1680/ 280	1.20

Industrial Fabrics

Industrial grey cotton goods, following recent brisk contract selling, moved into a slower, but not dull trading period. Among the reasons for the less active situation was the inability of mills to accommodate buyers seeking production which has eluded them while others preempted deliveries. There remain mills able to furnish yardage for shipment this year, but this brings to notice that repeatedly top-grade cloths are wanted and not simply accessibility of grades not of proven dependability.

There is general strength to prices which are at the peak of the upward quoted trend. Purchases have been made at the prices listed below, including sateens, broken twills, drills, osnaburgs, and sheetings. Yet there continued, in some directions, twilight zones in which yardages continued available at prices as low as those in effect at the mill end a month ago.

Chafer fabrics have had a little buyer interest bestowed on them by the other than Big Four tire makers. This reflects that tire replacements have helped some tire companies improve production and sales records. Some sales at below list levels persist, and along with instances of improved use of chafers has gone betterment of recent fabric prices.

Contracts have been placed for special or specification industrial cottons. These are not among the listed ones, but their placement accounts for the help given the market toward a broader contract movement that embraces more kinds of wide and heavy constructions.

(Continued on page 468)

Market Reviews

Industrial Fabrics

Broken Twills*

54-inch, 1.14, 76x52	*yd.*	$0.52
58-inch, 1.06, 76x52		.585
60-inch, 1.02, 76x52		.5825

Drills*

59-inch, 1.85, 68x40	*yd.*	.365
2.25, 68x40		.2975

Osnaburgs*

40-inch, 2.11, 35x25	*yd.*	.2275
3.65, 35x25		.1525
59-inch, 2.35, 32x26		.275
62-inch, 2.23, 32x26		.2875

Ducks

Enameling Ducks*

	S. F.	D. F.
38-inch, 1.78 yd.	$0.3263	.3313
2.00 yd.	.275	.28
51.5-inch, 1.35 yd.	.45	.46
57-inch, 1.22 yd.	.4838	.50
61.5-inch, 1.09 yd.	.5413	.5538

Army Duck†

52-inch, 11.70 oz., 54x40 (8.10 oz./sq.yd.)	*yd.*	.5925

Numbered Duck†

List less 45%

Hose and Belting Duck*

Basis	*lb.*	.60

Sheeting*

40-inch, 3.15, 64x64	*yd.*	.2175
3.60, 56x56		.185
52-inch, 3.85, 48x48		.2275
57-inch, 3.47, 48x48		.235
60-inch, 2.10, 64x64		.36
2.40, 56x56		.31

Sateens*

53-inch, 1.12, 96x60	*yd.*	.565
1.32, 96x64		.52
57-inch, 1.04, 96x60		.615
58-inch, 1.02, 96x60		.625
1.21, 96x64		.5725

Chafer Fabrics*

14.40-oz./sq.yd. P.Y.	*lb.*	.67
11.65-oz./sq.yd. S.Y.		.61
10.80-oz./sq.yd. S.Y.		.61
8.9-oz./sq.yd. S.Y.		.67
40-inch, 2.56, 35x25		.25
60-inch, 1.71, 35x25		.435

*Net 10 days.
†2% 10 days.

News about People

(Continued from page 447)

Harold E. Rose has been made vice president in charge of production for Newport Industries Co., division of Heyden Newport Chemical Corp., New York, N. Y. Mr. Rose succeeds **H. L. Marter,** who retired November 1, after 42 years in the naval stores and terpene chemicals business. Mr. Marter will continue to serve the company in a consulting capacity. Mr. Rose formerly was superintendent of the division's Oakdale, Fla., plant and has had experience in production in several other plants of the company.

Lawrence A. King will set up a technical service laboratory in the Los Angeles, Calif., area for Naugatuck Chemical Division, United States Rubber Co., New York, N. Y., to provide technical service to West Coast users of the company's polyester resin, Vibrin. He has been appointed Vibrin polyester plastic technical representative for the area. He will transfer from the development group on Vibrin at Naugatuck's main plant and laboratory in Naugatuck, Conn., where he has served for the past 18 months.

D. H. Killeffer, chemical public relations consultant, recently moved his office from Crestwood, Tuckahoe, N. Y., to 1033 Mohawk Dr., Clearwater, Fla. He has served leading companies and societies for nearly 40 years and has authored many books and articles as well as produced a number of industrial motion pictures.

Jose Eugenio Vicario, Argentine engineer, has been selected as recipient of the Goodyear Fellowship in Advanced Highway Engineering. A graduate of the University of Buenos Aires with a degree in civil engineering, Mr. Vicario has enrolled in the University of California's Bureau of Highway Traffic for a year of graduate work.

Obituaries

Louis Veillon

Louis Veillon, who was the first employe of Monsanto Chemical Co. when it was founded in 1901, died on November 11 at his estate at Erlenbach-Zurich, Switzerland. He was 84 years old.

A native of Zurich and a graduate of the Federal Polytechnic Institute there, Dr. Veillon came to the United States in 1901 to help the late John Francis Queeny when the latter found Monsanto. Queeny arranged to hire the Swiss chemist through Sandoz Chemicals Works in Switzerland, the organization which later supplied the basic chemicals for Monsanto's first product, saccharin.

Dr. Veillon constructed the first Monsanto operating plant in 45 days, doing much of the manual labor as well as the planning. It was his research work which allowed the young American chemical company to start operating.

During World War I, when the United States was deprived of German chemicals, Dr. Veillon was one of the leaders in building the American chemical industry almost overnight.

In 1919, when Monsanto made its first foreign investment in the Graesser-Monsanto Chemical Co., Ruabon, Wales, Dr. Veillon went there to build that company's first saccharin plant.

He retired from Monsanto in 1927 and returned to Switzerland.

Dr. Veillon is survived by his wife and three children.

Mrs. Bertha L. Seaman, 52, wife of our editor, passed away on November 1 after a long illness. She was a native of Nyack, N. Y., and a graduate of New York State Teachers College. Other survivors include a daughter, a son, a grandson, and two sisters.

News from Abroad

(Continued from page 449)

Austria

Montecatini Soc. Gen., of Milan, Italy, and Stickstoffwerke A.G., of Linz, an Austrian nationalized company, have jointly formed a new firm, Danubia Petrochemie A.G., which will produce chemical petroleum derivatives in Austria, it is announced. A factory will be erected near Vienna at Schwechat, in the vicinity of a large oil refinery to be built by Austrian interests. Each of the two concerns involved will put up 40% of the capital while the government will take the remaining 20% and offer it to private Austrian investors.

The new undertaking will produce about 5,000 metric tons of polypropylene a year, by the Natta process, using Italian technical know-how and skilled personnel; raw materials will at first also be of Italian origin until the Austrian oil refinery plant is in a position to supply these. Austria, it seems, expects eventually to have an output of over 3,000,000 tons of oil yearly, which would make her the second largest European oil source after Rumania. The Austrian polypropylene will be sold as Daplen.

Czechoslovakia

The erection near Prague of a large plant to make synthetic rubber from synthetic alcohol is provided for in the production program aiming at a 250% expansion of Czechoslovakia's chemical industry by 1965. The country's synthetic rubber requirements are at present in large part supplied by imports from the Soviet Union.

CLASSIFIED ADVERTISEMENTS

SITUATIONS OPEN

PRODUCTION MANAGER

PRECISION MOLDED GOODS MANUFACTURER LOOKING FOR well-qualified man to take charge of all production. Address Box No. 2264, care of RUBBER WORLD.

COMPOUNDER

NORTHERN OHIO PRECISION MOLDED GOODS MANUFACturing company looking for experienced compounder and qualified technical man. Address Box No. 2265, care of RUBBER WORLD.

SALES REPRESENTATIVE—TECHNICALLY MINDED TO HANdle complete line of protective and decorative coatings for rubber products. Nationally and internationally advertised. Used the world over. Address Box No. 2268, care of RUBBER WORLD.

WANTED!

ADHESIVE CHEMIST—Experienced with all types of rubber, synthetic resins and epoxy compounding. Growth opportunity with small, aggressive Midwest company. Submit complete work résumé including educational background. Address Box No. 2271, care of RUBBER WORLD.

INVESTIGATE SUNNY SOUTH CAROLINA

Research Director—Rubber and Resin Chemist, Ph.D. or equivalent. Mechanical Engineer, with rubber, plant engineering, design, and maintenance background. Send résumé today.

CONTINENTAL TAPES
Cayce, S. C.

SITUATIONS WANTED

MANUFACTURING EXECUTIVE. GRADUATE ENGINEER, AGE 36, Married. Proven success with 17 years' experience in factory management, product development, compounding, machinery design, and production trouble shooting. Aggressive and full of initiative. Cost reduction through modern industrial engineering techniques. Languages. Responsible position with progressive manufacturer desired. Address Box No. 2266, care of RUBBER WORLD.

CHEMIST—EXPERIENCED ALL PHASES RUBBER AND PLAStics processing, research, and development. Address Box No. 2267, care of RUBBER WORLD.

SALESMAN CALLING ON RUBBER PLANTS IN N. OHIO DEsires additional lines or products. Address Box No. 2273, care of RUBBER WORLD.

FACTORY MANAGER—AGE 41, WITH 25 YEARS' EXPERIENCE hard rubber Compounding and Molding. 15 years' experience in supervision of all phases of operations. Desires position with a progressive organization. Address Box No. 2272, care of RUBBER WORLD.

RUBBER TECHNOLOGIST: BROAD EXPERIENCE IN THE DEvelopment of latex compounds and solvent adhesives. Good background in plant production and sales. Desires production in development or technical service and/or sales. Address Box No. 2275, care of RUBBER WORLD.

PLANT MANAGER, 20 YEARS' DIVERSIFIED EXPERIENCE IN molded, extruded, and dipped goods. Chemically blown, and all types of solid products. Good technical background. Know all types of machinery, processes, quality control, and cost reduction. Have fine record in all phases of management, including personnel, labor relations, and sales organization. Must relocate for family health reasons. Far West, or Southwest preferred, but South or East acceptable. Address Box No. 2278, care of RUBBER WORLD.

RUBBER-PLASTICS CHEMIST-TECHNOLOGIST, QUALIFIED, experienced compounding natural and synthetic rubber, vinyl extrusions, and plastisols wishes to relocate in Eastern United States. Address Box No. 2277, care of RUBBER WORLD.

MACHINERY & SUPPLIES FOR SALE

SURPLUS EQUIPMENT

4—Blaw Knox 6' x 40' Horizontal Vulcanizers with quick-opening doors, 250# working pressure, ASME.
1—Bolling 3-roll Laboratory Calender, 8" x 16".
2—Royle #½ Extruders, complete.
1—Banbury Midget Mixer with 2 HP gear motor.
1—Farrel-Birmingham 3-roll Lab Calender, 6" x 12".
Address Box No. 2269, care of RUBBER WORLD.

FOR SALE: 36" MILL, 200-TON MOLDING PRESS, BALL MILLS, Sifters, Extruder, Banbury Mixer, Calender, Dicer, Granulators, B-P Mixer, 15 HP Boiler. UNIMAX CORP., 8200 Bessemer Ave., Cleveland 27, O.

FOR SALE: BANBURY MIXERS #11, 9. 1—FARREL 500/1500 HP Horiz. Reducer. 3—4' x 84" vert. Vulcanizers, quick-opening doors, ASME 120#, 6—465-gal. stainless Reactors, 150# W. P., 165# jkt. 5—Pfaudler 500-gallon glass-lined Reactors, 10—Baker-Perkins #17-200 gal. sigma blade Mixers. PERRY EQUIPMENT CORP., 1424 N. 6th St., Phila. 22, Pa.

MACHINERY & SUPPLIES FOR SALE (Cont'd.)

HYDRAULIC PRESSES, 2500-TON DOWNSTROKE 54" x 102". 325-ton upstroke 28" x 28". 300-ton upstroke 40" x 30". 300-ton upstroke 22" x 35". 250-ton French Oil upstroke 38" x 28". 140-ton 36" x 36" platens. 115-ton Farrel 24" x 24". Adamson 6" Rubber Extruder. New & Used Lab. 6" x 13", 6" x 16", and 8" x 16" Mills and Calenders, & sizes up to 84". Baker-Perkins & Day Heavy-Duty Jack. Mixers up to 200 gals. Hydraulic Pumps & Accumulators, Rotary Cutters. Colton 5½ T, 4T & 3DT Preform Machines motor driven. Other sizes in Single-Punch & Rotary Pre-Form Machines. Banbury Mixers, Crushers, Churns, Tubers, Vulcanizers, Bale Cutters, Gas Boilers, etc. SEND FOR SPECIAL BULLETIN. WE BUY YOUR SURPLUS MACHINERY. STEIN EQUIPMENT COMPANY, 107 8TH STREET, BROOKLYN 15, NEW YORK. STERLING 8-1944.

(Classified Advertisements Continued on Page 477)

STATISTICS

of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

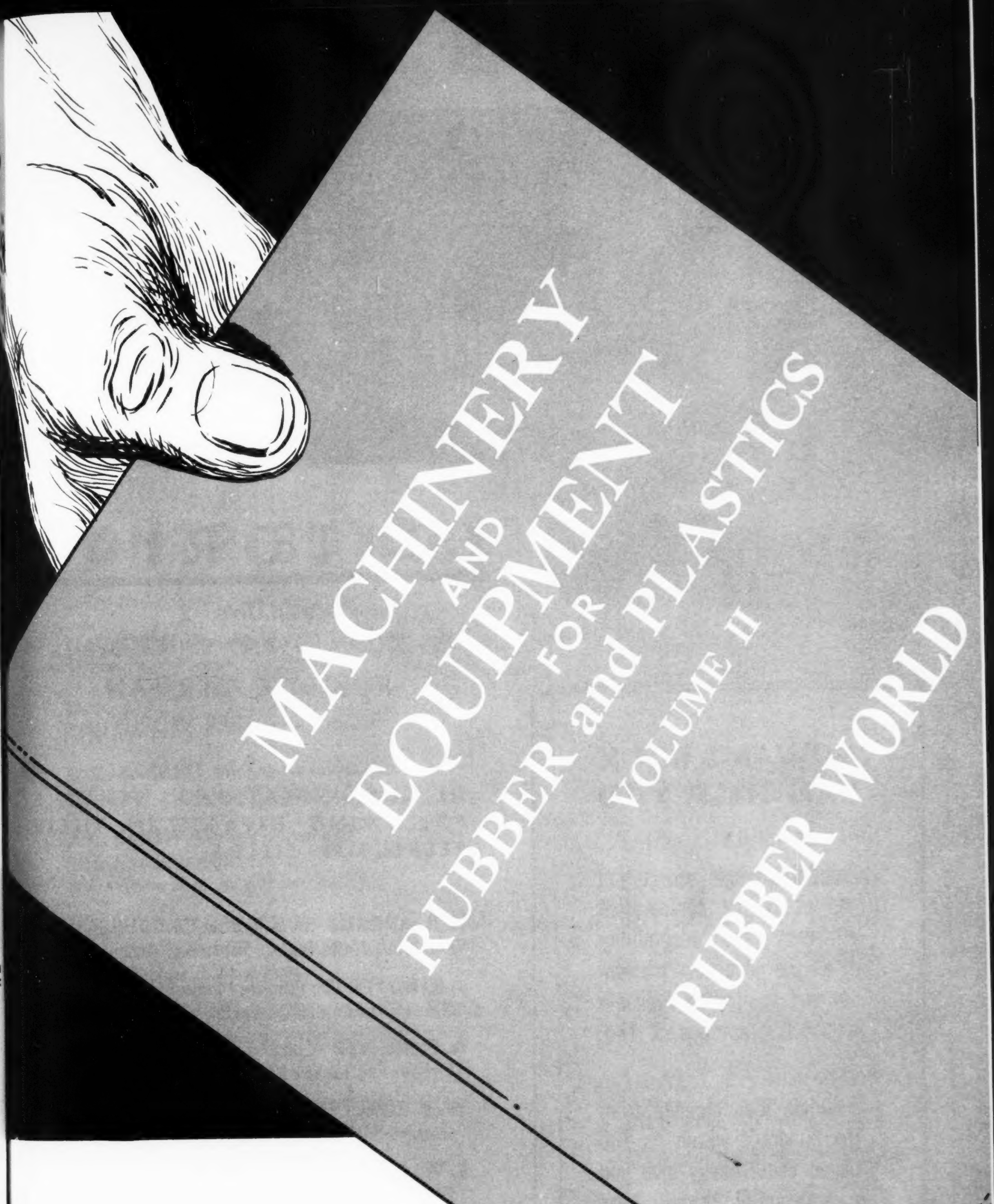
Year	Natural	GR-S	SBR Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1952	805,575	636,969	17,885	81,630	65,745	16,228	1,624,454
1953	647,614	668,386	12,342	79,801	80,495	20,198	1,508,837
1954	597,200	472,698	17,707	58,802	69,150	21,396	1,236,601
1955	637,577	236,556	564,589	56,179	91,357	32,623	1,616,478
1956	579,217	....	877,430	75,922	99,412	34,567	1,667,841
1957							
Jan.	46,349	....	76,224	6,366	9,432	2,893	141,264
Feb.	37,487	....	66,023	5,664	9,004	2,894	121,072
Mar.	40,680	....	76,546	6,460	8,031	3,291	135,008
Apr.	59,896	....	65,706	5,890	8,902	2,408	142,802
May	52,566	....	77,542	6,145	9,235	2,561	148,049
June	30,290	....	68,297	4,474	9,678	2,538	137,553
July	44,760	....	67,796	1,972	8,591	2,592	125,711
Aug.	48,951	....	76,197	5,455	9,033	2,737	142,373
Sept.	47,937	....	75,872	6,113	9,726	2,826	142,474
Oct.	49,371	....	87,709	6,085	9,545	3,062	155,772
Nov.	44,583	....	87,152	6,099	9,976	2,803	148,362
Dec.	53,922	....	85,223	6,469	9,568	2,519	157,701
Total	553,043	.....	907,534	66,936	110,721	33,124	1,671,358
1958							
Jan.	45,564	....	85,379	6,149	8,804	2,384	148,280
Feb.	46,018	....	66,402	4,996	8,200	2,157	127,773
Mar.	39,885	....	69,230	4,698	7,671	2,042	123,526
Apr.	41,278	....	59,263	4,324	7,973	2,197	115,035
May	36,183	....	62.161	4,462	7,450	2.338	112,594
June	28,279	....	62,567	1,926	7,251	2,306	102,329
July	25,823	....	64,944	3,698	6,248	2,193	102,906
Aug.	....	....	73,338	4,455	6,745	2,783	......
Sept.*	....	....	75,111	4,117	8,586	3,165	......

* Preliminary. Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	GR-S	SBR Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1952	453,846	648,816	17,604	71,229	55,522	13,866	1,260,883
1953	553,473	611,748	12,433	77,826	65,900	16,929	1,338,309
1954	596,285	483,001	17,344	61,464	57,203	17,715	1,233,412
1955	634,800	234,963	507,034	53,991	72,876	26,035	1,529,699
1956	562,088	....	724,028	49,581	74,852	25,933	1,436,482
1957							
Jan.	52,631	....	70,978	5,028	7,237	2,247	138,121
Feb.	46,427	....	64,322	4,581	6,235	2,122	123,687
Mar.	48,263	....	67,853	4,998	6,559	2,240	129,913
Apr.	45,368	....	63,280	4,651	6,295	2,129	121,723
May	46,385	....	66,774	4,902	6,441	2,125	126,753
June	41,282	....	58,479	4,198	5,816	1,963	111,738
July	39,683	....	58,021	4,146	5,231	1,646	108,833
Aug.	44,846	....	66.089	4,461	6,502	2,220	124,204
Sept.	43,527	....	64,505	4,654	6,351	2,141	121,326
Oct.	48,782	....	73,850	5,343	7,194	2,433	137,602
Nov.	43,816	....	62,635	4,521	6,136	2,110	119,218
Dec.	38,285	....	56,432	3,930	5,464	1,811	105,922
Total	538,761	....	767,218	55,813	75,661	25,187	1,462,640
1958							
Jan.	42,597	....	60,179	4,508	5,928	2,010	115,222
Feb.	36,711	....	52,962	4,255	5,045	1,968	100,941
Mar.	38,191	....	54,816	4,297	4.965	1,962	104.231
Apr.	36,608	....	55,133	4,621	4,962	1,897	103,221
May	36,014	....	55,463	4,258	4,805	1,778	102,318
June	37,607	....	58.507	4.402	4,844	2.053	107,413
July	34,235	....	53,903	3,791	4,454	1,717	98,190
Aug.	39,444	....	59,458	4,277	5,719	2,308	111,206
Sept.*	44,814	....	64,860	4,725	6,405	2,471	123,275

* Preliminary. Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.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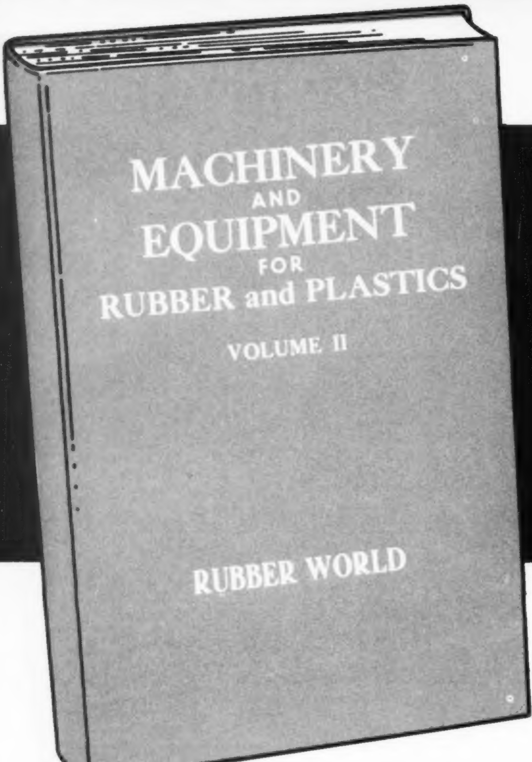

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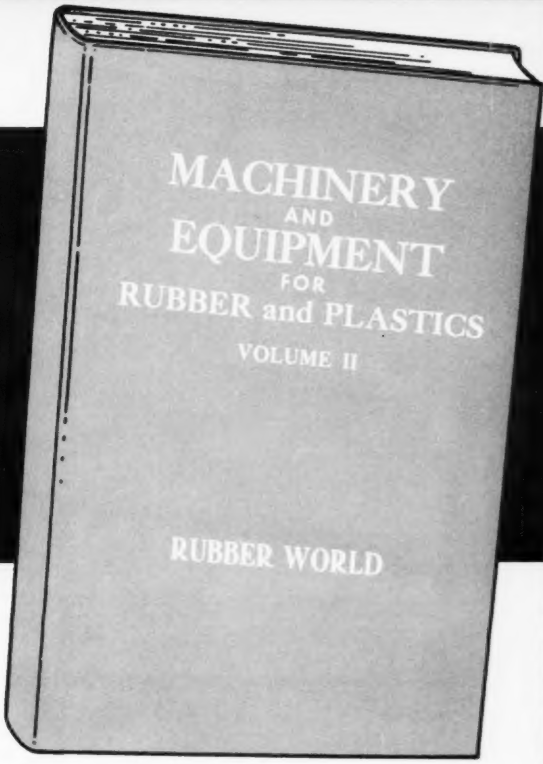

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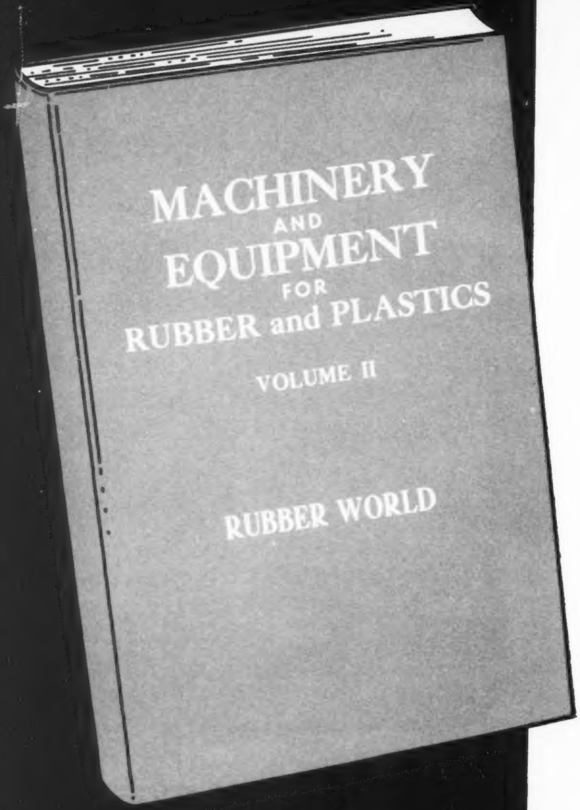

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U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1957						
Jan.	11,831	7,191	1,329	1,936	10,456	22,287
Feb.	9,940	7,415	1,169	2,051	10,635	20,575
Mar.	10,173	7,689	1,170	2,157	11,016	21,189
Apr.	12,064	8,096	1,183	1,836	11,115	23,179
May	11,733	7,885	1,407	1,710	11,002	22,735
June	10,931	8,139	1,377	2,001	11,517	22,448
July	12,073	8,045	1,296	1,953	11,294	23,367
Aug.	13,535	7,997	1,309	1,545	10,851	24,386
Sept.	12,315	7,566	1,141	1,700	10,407	23,722
Oct.	12,399	7,254	1,142	1,723	10,119	22,518
Nov.	12,316	7,558	1,265	1,927	10,750	23,066
Dec.	14,454	8,347	1,367	2,374	12,088	26,542
1958						
Jan.	14,178	8,222	1,190	2,052	11,464	25,642
Feb.	15,506	7,992	1,251	2,297	11,540	27,046
Mar.	16,825	7,991	1,281	1,974	11,246	28,071
Apr.	17,415	7,756	1,398	1,744	10,898	28,313
May	17,604	7,240	1,292	1,732	10,264	27,868
June	17,078	7,337	1,267	1,888	10,492	27,570
July	15,516	6,693	1,312	1,990	9,995	25,511
Aug.	13,750	7,166	1,195	2,049	10,410	24,160
Sept.†	12,482	6,842	1,354	2,096	10,292	22,774

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce. *Includes SBR Types. † Preliminary.

U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	SBR Types	Butyl	Neoprene	N-Type	Total
1957					
Jan.	13,989	207	2,500	540	17,236
Feb.	13,353	439	2,505	482	16,779
Mar.	13,664	1,014	2,466	781	17,925
Apr.	10,625	372	2,244	620	13,861
May	12,208	603	2,480	517	15,808
June	13,886	762	2,315	492	17,455
July	14,444	1,169	3,426	631	19,670
Aug.	13,795	758	2,786	478	17,817
Sept.	11,625	540	1,964	396	14,525
Oct.	12,200	1,261	2,588	467	16,516
Nov.	12,639	809	2,521	410	16,379
Dec.	15,549	814	2,447	563	19,373
Total	158,017	8,832	30,242	6,377	203,468
1958					
Jan.	14,109	1,626	2,649	513	18,897
Feb.	9,947	1,415	2,626	378	14,366
Mar.	15,647	757	3,424	410	20,238
Apr.	11,583	949	2,356	698	15,586
May	14,067	1,218	2,899	784	18,968
June	11,995	1,022	1,562	473	15,052
July	10,602	1,051	2,403	674	14,730
Aug.	8,521	972	2,603	558	12,654

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	SBR Types	Butyl	Neoprene	N-Type	Total
1957					
Jan.	143,177	29,810	13,073	7,664	193,724
Feb.	134,587	29,951	12,705	7,565	184,808
Mar.	131,255	30,814	11,949	7,795	181,813
Apr.	122,764	31,536	12,064	7,247	173,611
May	121,638	31,812	13,010	6,981	173,441
June	120,694	31,569	13,822	7,085	173,170
July	113,143	28,208	15,172	7,125	163,648
Aug.	111,962	28,339	14,603	6,784	161,688
Sept.	109,417	29,132	14,751	7,207	160,507
Oct.	113,382	29,008	15,181	7,134	164,705
Nov.	124,432	29,702	16,453	7,380	177,967
Dec.	140,199	31,489	18,943	7,954	198,585
1958					
Jan.	152,441	31,753	18,691	7,512	210,397
Feb.	151,501	31,369	18,408	7,635	208,914
Mar.	153,221	30,796	18,504	6,947	209,468
Apr.	143,981	30,012	18,764	6,469	199,226
May	137,277	29,246	19,014	6,392	191,929
June	132,800	25,954	18,736	6,231	183,721
July	132,303	24,882	18,242	6,097	181,524
Aug.	136,735	24,618	16,344	6,224	183,921
Sept.*	138,987	22,554	15,154	6,145	182,840

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce. *Preliminary.

U.S.A. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1957						
Jan.	6,994	6,288	856	841	7,985	14,979
Feb.	6,398	5,894	758	708	7,360	13,758
Mar.	7,081	6,370	784	799	7,953	15,034
Apr.	6,434	5,554	772	710	7,036	13,470
May	5,867	5,114	814	731	6,659	12,526
June	5,445	4,790	736	610	6,136	11,681
July	5,180	4,269	677	480	5,426	10,606
Aug.	6,499	5,758	784	823	7,365	13,864
Sept.	6,645	5,676	712	753	7,141	13,786
Oct.	7,250	6,556	788	857	8,201	15,451
Nov.	6,783	5,776	725	712	7,213	13,996
Dec.	5,933	5,260	633	606	6,499	12,432
Total	75,009	68,305	9,539	10,230	88,074	163,083
1958						
Jan.	6,380	5,438	806	683	6,927	13,307
Feb.	5,380	4,475	640	806	5,921	11,301
Mar.	5,560	4,708	633	720	6,061	11,621
Apr.	4,847	4,093	707	797	5,597	10,444
May	5,004	4,102	785	795	5,682	10,686
June	5,304	4,165	639	919	5,723	11,027
July	4,531	3,433	629	703	4,765	9,296
Aug.	6,094	4,654	764	1,025	6,443	12,537
Sept.†	6,748	5,779	820	1,017	7,616	14,364

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce. *Includes SBR Types. † Preliminary.

U.S.A. Rubber Industry Sales and Inventories

(Millions of Dollars)

	Value of Sales*				Manufacturers' Inventories*			
	1955	1956	1957	1958	1955	1956	1957	1958
Jan.	424	415	496	448	790	935	1,047	1,100
Feb.	440	445	495	413	782	970	1,036	1,087
Mar.	466	451	476	412	805	979	1,030	1,112
Apr.	445	445	490	429	784	970	1,031	1,047
May	465	464	481	428	810	985	1,024	1,020
June	465	450	458	445	850	975	1,027	986
July	471	459	514	473	853	987	1,045	960
Aug.	456	436	481	...	863	1,007	1,074	....
Sept.	456	429	481	...	874	1,007	1,074	....
Oct.	447	454	490	...	902	1,022	1,097	....
Nov.	482	463	431	...	935	1,024	1,101	....
Dec.	465	461	427	...	934	998	1,092	....
Total	5,493	5,372	5,720	... Av.	845	988	12,678	....

Source: Office of Business Economics, United States Department of Commerce.
*Adjusted for seasonal variation.

U.S.A. Production of Cotton, Rayon, and Nylon Tire Fabrics

(Thousands of Pounds)

	Cotton and Nylon*		Rayon Tire Cord		
	Cotton Chafer Fabrics and Other Tire Fabrics	Cotton and Nylon Tire Cord and Fabrics	Woven	Not Woven	Total All Tire Cord and Fabrics
1957					
Jan.-Mar.	11,028	20,676	69,610	21,872	124,297
Apr.-June	10,456	24,852	63,195	16,037	115,418
July-Sept.	9,102	24,852	54,968	10,509	100,046
Oct.-Dec.	9,207	23,868	58,356	9,216	100,647
1958					
Jan.-Mar.	9,750	18,280	56,522	8,372	167,924
Apr.-June	7,890	24,725	†	†	80,533
July-Sept.	7,999	24,904	†	†	91,984

* Cotton and nylon figures combined to avoid disclosing data for individual companies. † Withheld to avoid disclosing figures for individual companies.
Source: Bureau of the Census, United States Department of Commerce.

U.S.A. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1957						
Jan.	6,460	7,228	905	960	9,093	15,553
Feb.	4,342	6,481	724	1,035	8,240	12,582
Mar.	5,856	7,227	824	1,127	9,278	15,134
Apr.	8,812	6,306	976	881	8,163	16,975
May	5,794	5,495	1,082	933	7,510	13,304
June	4,809	5,251	819	886	6,956	11,765
July	6,243	4,646	572	844	6,062	12,305
Aug.	6,834	6,816	874	608	8,298	15,132
Sept.	5,516	5,649	917	1,285	7,851	15,268
Oct.	8,351	6,876	885	1,133	8,894	14,811
Nov.	6,496	6,515	1,021	994	8,530	15,026
Dec.	7,572	5,915	704	734	7,353	14,925
Total	69,513	74,405	10,403	11,637	96,445	165,958
1958						
Jan.	6,289	5,998	788	785	7,571	13,860
Feb	7,013	3,852	765	671	5,288	12,301
Mar	7,147	4,880	759	787	6,426	13,573
Apr	6,348	3,889	907	830	5,626	11,974
May	4,121	3,635	808	882	5,325	9,446
June	4,323	4,539	696	890	6,125	16,573
July	3,158	3,645	677	893	5,215	13,588
Aug.	....	5,474	892	1,103	7,469	....
Sept.†	....	6,165	1,075	1,173	8,413	....

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce. *Includes SBR types. †Preliminary.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1957				
Jan.	25,103	24,053	1,288	34,552
Feb.	21,896	22,773	1,263	32,010
Mar.	25,088	24,633	1,298	30,975
Apr.	22,878	23,145	1,201	30,258
May	24,884	23,816	1,277	29,847
June	22,402	21,352	1,083	30,378
July	20,444	19,676	757	29,972
Aug.	20,423	22,429	917	28,521
Sept.	19,892	21,704	714	25,983
Oct.	26,419	24,925	1,230	27,171
Nov.	22,083	20,583	1,150	27,855
Dec.	20,101	18,263	843	29,323
Totals	273,989	266,852	13,021	29,323
1958				
Jan.	21,159	21,186	892	29,569
Feb.	18,319	18,130	665	28,838
Mar.	19,601	19,300	1,025	28,984
Apr.	19,818	19,746	832	29,440
May	18,942	20,104	1,012	27,862
June	20,549	20,652	1,024	27,763
July	18,136	18,350	1,087	26,442
Aug.	22,432	19,347	900	27,961
Sept.*	22,596	21,771	....	26,676

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce. * Preliminary.

Carbon Black Statistics — Nine Months, 1958

Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; GPF, general-purpose furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, super abrasion furnace black; ISAF, intermediate super abrasion furnace black.

(Thousands of Pounds)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Production									
Furnace types									
Thermal	12,159	10,070	11,942	10,436	9,378	9,598	10,282	9,049	9,060
SRF	22,104	17,946	18,714	14,587	14,750	14,094	18,986	18,539	18,799
HMF	5,769	3,190	5,242	4,302	5,257	6,383	5,134	5,463	5,706
GPF	4,470	4,852	4,632	4,872	5,183	4,418	4,874	5,680	5,230
FEF	16,992	16,398	18,272	17,880	13,384	14,141	14,776	17,472	17,714
HAF	39,384	32,054	33,735	42,134	35,256	35,817	40,137	39,389	41,387
SAF	—	728	968	934	67	82	—	47	—
ISAF	13,888	14,739	16,522	12,782	11,011	10,007	14,626	16,551	15,066
Total furnace	115,330	99,977	110,027	107,927	94,286	94,540	108,815	112,190	112,962
Contact types	28,574	25,712	27,328	26,051	26,623	26,105	28,134	27,946	26,375
Totals	143,904	125,689	137,355	133,978	120,909	120,645	136,949	140,136	139,337
Shipments									
Furnace types									
Thermal	12,237	8,648	8,762	10,034	8,126	8,703	9,260	10,121	12,552
SRF	21,706	18,360	19,869	23,201	19,589	18,612	19,796	22,062	23,341
HMF	5,320	5,030	4,355	5,735	4,682	6,066	6,309	5,086	5,561
GPF	5,589	4,793	3,721	4,267	3,945	4,885	5,146	4,947	5,025
FEF	17,609	17,285	16,780	17,988	15,821	14,908	18,607	19,442	19,965
HAF	35,550	32,938	34,433	37,390	36,802	36,620	38,425	39,054	41,014
SAF	531	387	560	358	319	809	769	551	931
ISAF	14,359	12,590	14,332	14,310	13,254	13,181	15,489	17,050	15,922
Total furnace	112,901	100,031	102,812	113,283	102,547	103,784	113,801	118,313	124,311
Contact types	25,571	23,072	23,617	25,863	26,091	23,106	23,645	25,058	24,751
Totals	138,472	123,303	126,429	139,146	128,638	137,446	137,446	143,371	149,062
Producers' Stocks, End of Period									
Furnace types									
Thermal	20,086	21,508	24,688	25,090	23,342	27,237	28,259	27,187	23,695
SRF	75,022	74,608	73,453	64,906	60,123	55,605	54,795	51,312	46,770
HMF	10,674	8,834	9,721	8,288	8,863	9,180	8,005	8,382	8,527
GPF	8,409	8,468	9,379	9,917	11,090	10,623	10,351	11,044	11,249
FEF	32,930	32,043	33,535	33,427	30,990	30,223	26,392	24,422	22,171
HAF	57,104	56,220	55,522	60,266	58,720	57,917	59,629	59,964	60,337
SAF	7,388	7,729	8,137	8,713	8,457	7,730	6,961	6,457	5,526
ISAF	49,406	51,555	53,745	52,217	49,974	46,800	45,937	45,438	44,582
Total furnace	261,019	260,965	268,180	262,824	254,559	245,315	240,329	234,206	222,857
Contact types	83,776	86,216	89,927	89,885	90,417	93,141	97,630	100,518	102,142
Totals	344,795	347,181	358,107	352,709	344,976	338,456	337,959	334,724	324,999
Exports									
Furnace types									
Total furnace	23,723	22,719	25,720	24,534	21,879	22,417	24,871	....	....
Contact types	13,519	10,933	14,018	12,143	12,698	13,369	10,970	....	....
Totals	37,242	33,652	39,738	36,677	34,577	35,786	35,841	....	....

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

MACHINERY & SUPPLIES FOR SALE (Cont'd)

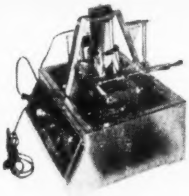
FOR SALE: 3A BANBURY PRESENTLY IN PRODUCTION ON West Coast. Available for inspection. Address Box No. 2274, care of RUBBER WORLD.

FOR SALE: RUBBER BAND CUTTING MACHINE, GUILLOTINE type, complete with 1 HP motor, switch and extra set of knives. Like new, below cost $700. O. R. CAPRON, P.O. Box 85, Slidell, La.

(Classified Advertisements Continued on Page 479)

TESTED IS TRUSTED

SCOTT MODEL E
for conformance with
MIL-C-12064A (CE)



"For Cable, Power, Electric, 600-volt, for field use the (insulation) brittleness shall be evaluated by the solenoid operated American Cyanamid tester." This specification pin-points the applicability of the Scott Model E Brittleness Tester for this test.

SCOTT TESTERS
*Trademark

SCOTT TESTERS, INC.
90 Blackstone St., Providence, R. I.

NEW CONCEPT

in calender and mill frame construction — frames of fabricated steel weldments — lifetime guarantee — new machines built in any size

Guaranteed
NEW · USED · REBUILT MACHINERY
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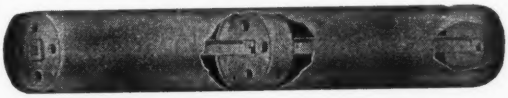
DIVISION OF BOTWINIK BROTHERS OF MASS., INC.
SHERMAN RUBBER MACHINERY CO.

STEEL CALENDER STOCK SHELLS



ALL STEEL, ALL WELDED CONSTRUCTION, with forged steel hubs for 1¼", 1½" and 2" square bars. 4", 5", 6", 8", 10", 12", 15", 20" and 24" diameters. Any length. Also Special Trucks (Leaf Type) Racks, Tables and Jigs.

Used in manufacturing rubber and plastic products.

THE W. F. GAMMETER COMPANY
CADIZ, OHIO

LIQUIDATION SALE

USED MACHINERY FOR RUBBER AND PLASTICS

ALL SALES ON "AS IS, WHERE IS" BASIS FROM THE AKRON, OHIO, AND TRENTON, N. J., WAREHOUSES OF

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BELLANCA CORPORATION

Mixing Mills	Pumping Units
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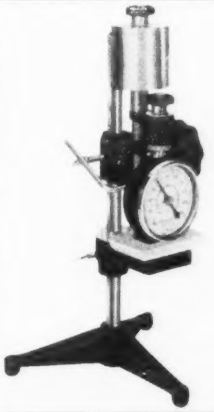

RUBBER HARDNESS

ORIGINAL SHORE

DUROMETER

ASTM D676 AND ASTM D1484

Various models for testing the entire range of hardness from elastomeric to rigid. Available in quadrant or round dial case. May be used free hand or on table top OPERATING STAND WITH DEAD WEIGHT (left).

THE SHORE INSTRUMENT & MFG. CO., INC.
90-35 VAN WYCK EXP., JAMAICA 35, N.Y.

CUTTING—RUBBER—SOLES
NEW WELLMAN MACHINE

UNVULCANIZED RUBBER OR PLASTIC
BEVEL OR STRAIGHT EDGE
CUT PRECISION SOLES UP TO 1" THICK

WELLMAN CO., MEDFORD, MASS., U. S. A.

GUARANTEED REBUILT MACHINERY

IMMEDIATE DELIVERIES FROM STOCK

MILLS, CALENDERS, TUBERS
VULCANIZERS, ACCUMULATORS

HYD. PRESSES, PUMPS, MIXERS
CUTTING MACHINES, PULVERIZERS

UNITED RUBBER MACHINERY EXCHANGE

183-189 ORATON ST. CABLE "URME" NEWARK 4, N. J.

World Production of Synthetic Rubber

(1,000 Long Tons)

Year	U.S.A.	Canada	Germany	Total
1957				
May	95.0	11.5	0.8	107.3
June	84.4	11.3	1.1	96.8
July	81.0	10.1	0.8	91.9
Aug.	93.4	11.0	1.1	105.6
Sept.	94.5	10.9	1.0	106.4
Oct.	106.4	11.4	1.1	118.9
Nov.	106.0	11.5	1.0	118.5
Dec.	103.8	11.5	0.6	115.9
1957 total	1,118.3	132.1	11.6	1,262.0
1958				
Jan.	102.7	10.9	1.8	115.4
Feb.	81.8	9.1	1.0	91.9
Mar.	83.6	11.3	1.2	96.2
Apr.	73.8	11.1	1.1	85.9
May	76.4	11.2	1.2	88.8
June	74.1	10.2	1.1	85.4
July	77.1	11.2	1.0	89.3
Aug.	87.3	10.9	...	...

Source: Secretariat of the International Rubber Study Group; and Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

World Production of Natural Rubber

(1,000 Long Tons)

Year	Malaya Estate	Malaya Native	Indonesia Estate	Indonesia Native	All Other	Total
1957						
May	27.2	18.3	18.1	30.4	43.5	137.5
June	29.7	21.6	20.4	29.5	43.8	145.0
July	32.5	24.1	21.0	65.9	46.5	192.5
Aug.	33.0	23.2	21.8	52.4	44.8	175.0
Sept.	31.5	21.4	21.8	37.8	35.0	157.5
Oct.	33.4	22.6	22.2	32.8	54.0	165.0
Nov.	34.4	22.7	22.2	24.5	51.2	155.0
Dec.	32.4	22.1	21.1	32.4	62.0	170.0
1957 total	369.8	268.9	252.2	432.3	556.7	1,892.5
1958						
Jan.	35.8	25.4	22.5	11.5	52.5	145.0
Feb.	28.8	22.9	20.0	8.8	37.0	117.5
Mar.	28.4	20.3	19.7	27.5	46.5	142.5
Apr.	26.7	18.3	16.8	24.0	44.2	130.0
May	27.2	18.2	17.7	20.1	44.3	127.5
June	31.2	21.9	19.7	26.0	43.7	142.5
July	36.5	23.8	20.8	45.3	48.5	175.0
Aug.	34.0	24.8	19.5	42.9	48.8	170.0

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce; Secretariat of the International Rubber Study Group.

World Consumption of Natural Rubber

(1,000 Long Tons)

Year	United States	Eastern Europe and China	United Kingdom	Other Foreign	Total Foreign	Grand* Total
1957						
May	46.5	10 3	14.5	79.3	104.1	150.6
June	41.3	25.4	17.2	74.8	117.4	158.7
July	39.7	25.3	14.0	76.2	115.5	155.0
Aug.	44.9	28.0	9.7	66.8	104.5	150.0
Sept.	43.7	18.7	18.1	78.4	115.2	157.5
Oct.	48.8	12 2	15.3	75.7	106.2	155.0
Nov.	43.8	19.2	15.1	...	108.8	152.5
Dec.	38.3	18.5	17.7	70.8	104.2	142.5
1957 total	539.8	263.5	181.6	885.5	1,330.2	1,870.0
1958						
Jan.	42.6	21.8	15.3	73.5	110.6	152.5
Feb.	36.7	30.5	16.1	71.5	118.1	155.0
Mar.	38.2	31.6	16.9	73.7	122.2	160.0
Apr.	36.6	43.0	13.4	72.8	115.6	165.0
May	36.0	28.7	14.7	71.6	100.3	150.0
June	37.6	43.7	16.1	74.6	129.9	167.5
July	34.2	27.9	12.7	74.0	115.8	150.0
Aug.	39.4	...	8.7	...	....	150.0

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce; and Secretariat of the International Rubber Study Group.
*Estimated.

U.S.A. Synthetic Rubber Industry, Wages, Hours

Year	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
1957			
May	105.93	40.9	2.59
June	103.88	39.8	2.61
July	108.75	41.2	2.64
Aug.	109.34	40.8	2.68
Sept.	108.40	40.6	2.67
Oct.	108.14	40.5	2.67
Nov.	112.73	41.3	2.73
Dec.	112.34	41.3	2.72
1958			
Jan.	109.62	40.6	2.70
Feb.	109.21	40.6	2.69
Mar.	110.03	40.6	2.71
Apr.	108.14	40.2	2.69
May	110.03	40.6	2.71
June	112.61	41.1	2.74
July	111.79	40.8	2.74

Source: BLS, United States Department of Labor.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U.S.A.	Canada	United Kingdon	Total† Continent of Europe	World† Grand Total
1957					
May	80.2	4.7	4.8	12.5	107.5
June	70.5	4.2	5.5	12.3	97.5
July	69.0	3.5	4.3	14.0	97.5
Aug.	79.3	2.8	3.0	11.2	102.5
Sept.	77.7	3.7	6.4	14.0	110.0
Oct.	88.8	4.1	5.5	14.8	120.0
Nov.	75.4	4.0	5.0	14.0	105.0
Dec.	67.6	3.6	6.0	13.3	95.0
1957 total	929.3	47.5	57.4	154.8	1,262.5
1958					
Jan.	72.6	3.5	5.2	14.0	100.0
Feb.	64.2	3.5	5.2	13.5	92.5
Mar.	66.0	3.5	6.6	14.3	97.5
Apr.	66.6	3.8	4.7	13.5	95.0
May	66.3	4.0	5.5	13.3	95.0
June	69.8	4.5	6.0	13.5	100.0
July	63.9	3.9	4.7	13.8	92.5
Aug.	71.8	3.0	3.1	...	95.0

Source: Secretariat of the International Rubber Study Group; Bureau of the Census, Industry Division, Chemical Branch, U. S. Department of Commerce.
* Includes latices. † Figures estimated or partly estimated.

U.S.A. Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1957						
May	301	2,827	86	3,214	3,548	7,422
June	275	3,141	69	3,485	3,025	6,946
July	258	3,364	86	3,708	2,941	6,287
Aug.	243	3,358	81	3,683	3,134	5,966
Sept.	213	3,180	90	3,483	3,365	6,174
Oct.	242	2,809	121	3,172	3,764	6,909
Nov.	259	2,468	65	2,792	2,585	6,250
Dec.	225	2,392	101	2,717	2,778	7,671
1957 total	3,045	35,684	1,077	39,806	39,763	
1958						
Jan.	232	4,005	71	4,309	3,344	6,699
Feb.	209	3,014	73	3,296	3,443	6,983
Mar.	209	3,481	74	3,764	3,685	7,066
Apr.	223	2,956	64	3,243	3,624	7,609
May	225	2,742	68	3,035	3,530	8,189
June	202	3,332	67	3,601	3,476	8,156
July	215	3,174	76	3,466	2,890	7,680
Aug.	160	3,097	74	3,331	3,305	7,664
Sept.	207	3,228	63	3,498	3,390	7,657

Source: The Rubber Manufacturers Association, Inc.

MACHINERY & SUPPLIES FOR SALE (Cont'd)

FOR SALE—1—16" x 40"—2-ROLL THROPP MILL, 50 HP; 1 Royle 10" strainer, 150 HP; 1 Farrel 16" x 48"—3-roll calender; 1—6" x 12"—2-roll Thropp mill; also cutters, presses, mixers, etc. CHEMICAL & PROCESS MACHINERY CORP., 52 Ninth Street, Brooklyn 15, N. Y.

CALENDER: FARREL 2-ROLL, 10" x 17".

EXTRUDERS: NRM 1½", COMPLETE PLASTIC WIRE COATING Unit: NRM 2" Saran; Royle 3¼", 15 HP Vari-Drive; Adamson 8".

INJECTION MACHINES: WATSON-STILLMAN 4 OZ. VERTICAL; Reed-Prentice 6 oz. and 16 oz., Impco 22 oz.

HYDRAULIC PRESSES: STOKES 15-TON, MODEL 200D-3; FULL Automatic; Loomis & Francis 40-Ton, Multi-Opening; Baldwin-Southwark 75-Ton; Watson-Stillman 75-Ton, Semi-Auto., Self-Contained (2); Watson-Stillman & HPM 100-Ton; Elmes 200-Ton; Watson-Stillman 400-Ton; Farrel 625-Ton.

PREHEATERS: G. E. 1.5 AND 5 K.W.

PELLETIZERS, ROTARY SCRAP CUTTERS, MILLS, MIXERS, Banburys, Boilers, Machine Tools, etc.

HOCHMAN PLASTICS MACHINERY CORPORATION, 151-W Mulberry St., Newark, N. J. MItchell 3-8430.

BUSINESS OPPORTUNITIES

IF YOU MOLD FOAM RUBBER OR LATEX PRODUCTS, AND could arrange a branch production and marketing of a wonderful new comfort invention; if you see many conflicting duplications, too many of same commodities crowding markets, and like something unique, here it is! Address Box No. 2270, care of RUBBER WORLD.

FOR SALE: A SMALL MOLDED GOODS PLANT IN NEW ENGland doing approximately $350,000.00 per year. Business is on a profitable basis and can easily be moved. No real estate involved. Address Box No. 2276, care of RUBBER WORLD.

U.S.A. Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
Passenger Car						
1956	30,874	42,411	876	85,000	95,546	16,494
1957						
Jan.	3,192	4,521	100	7,812	8,296	16,978
Feb.	3,017	4,453	68	7,538	8,047	17,376
Mar.	3,051	4,875	80	8,006	8,629	18,065
Apr.	2,809	5,218	78	8,104	7,878	17,821
May	2,831	5,166	60	8,057	8,313	18,050
June	2,623	5,532	63	8,217	7,462	17,322
July	2,719	5,826	65	8,611	7,449	16,097
Aug.	2,886	5,675	66	8,627	7,801	15,348
Sept.	1,398	5,096	70	6,564	7,535	16,310
Oct.	2,298	4,392	88	6,778	8,437	17,998
Nov.	3,179	3,250	62	6,491	6,575	15,596
Dec.	2,803	2,858	78	5,739	6,597	19,818
Total	32,724	56,605	888	90,217	93,547	19,818
1958						
Jan.	2,376	4,838	50	7,264	6,740	19,298
Feb.	1,998	3,777	57.5	5,833	6,320	19,820
Mar.	1,845	4,726	49.3	6,621	6,569	19,786
Apr.	1,594	5,517	61.4	7,173	6,522	19,051
May	1,874	5,593	55.8	7,523	6,715	18,263
June	1,667	6,387	62.8	8,117	7,306	17,465
July	1,756	6,502	60.0	8,318	6,368	15,490
Aug.	847	5,807	57.2	6,711	6,753	15,535
Sept.	1,170	5,425	63.9	6,659	7,134	16,045
Truck and Bus						
1956	4,548	8,894	883	14,326	14,589	3,378
1957						
Jan.	305	678	83	1,066	1,208	3,512
Feb.	344	598	59	1,001	1,122	3,633
Mar.	330	704	74	1,107	1,136	3,678
Apr.	438	771	49	1,277	1,072	3,486
May	399	620	74	1,094	1,178	3,580
June	370	715	64	1,149	1,027	3,461
July	349	819	61	1,229	994	3,219
Aug.	328	813	65	1,206	1,117	3,129
Sept.	290	805	63	1,158	1,105	3,083
Oct.	322	959	94	1,375	1,271	2,987
Nov.	337	626	59	1,021	1,060	3,207
Dec.	266	484	70	820	1,018	3,408
Total	4,041	8,544	845	13,430	13,394	3,408
1958						
Jan.	277	674	57	1,007	1,074	3,470
Feb.	254	598	52	904	994	3,572
Mar.	269	608	46	923	1,004	3,659
Apr.	282	666	55	1,002	955	3,607
May	299	626	54	980	938	3,571
June	265	794	54	1,113	988	3,456
July	265	940	51	1,255	920	3,114
Aug.	208	871	57	1,136	1,009	2,986
Sept.	273	940	41	1,253	1,143	2,880
Total Automotive						
1956	35,423	62,147	1,759	99,327	100,407	19,872
1957						
Jan.	3,496	5,199	183	8,878	9,504	20,490
Feb.	3,361	5,052	127	8,539	9,169	21,009
Mar.	3,381	5,579	154	9,114	9,766	21,743
Apr.	3,246	5,989	146	9,381	8,950	21,308
May	3,230	5,787	134	9,150	9,490	21,630
June	2,993	6,247	127	9,366	8,489	20,783
July	3,068	6,646	126	9,840	8,443	19,316
Aug.	3,214	6,488	130	9,833	8,917	18,477
Sept.	1,688	5,902	133	7,723	8,641	19,393
Oct.	2,620	5,351	182	8,154	9,708	20,985
Nov.	3,516	3,876	121	7,513	7,636	18,803
Dec.	3,070	3,341	148	6,559	7,615	23,225
Total	36,764	65,150	1,734	103,647	106,941	23,225
1958						
Jan.	3,653	5,511	107	8,271	7,814	22,769
Feb.	2,253	4,374	110	6,737	7,314	23,392
Mar	2,114	5,334	95	7,543	7,573	23,446
Apr.	1,876	6,183	116	8,175	7,477	22,658
May	2,173	6,220	110	8,503	7,652	21,834
June	1,932	7,182	117	9,231	8,293	20,920
July	2,020	7,442	111	9,573	7,288	18,604
Aug.	1,055	6,679	115	7,848	7,762	18,521
Sept.	1,442	6,365	105	7,912	8,277	18,925

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumer's Price Index
All Rubber Products					
1939	121.0	$27.84	39.9	$0.75	
1957					
Apr.	191.3	87.60	40.0	2.19	119.3
May	204.6	88.80	40.0	2.22	119.6
June	196.8	91 21	40.9	2.23	120.2
July	199.9	94.16	41.3	2.28	120.8
Aug.	204.3	92.84	40.9	2.27	121.0
Sept.	206.4	93.02	40.8	2.29	121.1
Oct.	209.5	93.03	40.1	2.32	121.1
Nov.	209.0	93.20	40.0	2.33	121.6
Dec.	207.3	92.40	40.0	2.31	121.6
1958					
Jan.	260.5	87.48	38.2	2.29	122.3
Feb.	256.9	85.04	37.3	2.28	122.5
Mar.	243.6	87.02	38.0	2.29	123.5
Apr.	234.7	85.88	37.5	2.29	123.6
May	230.5	87.86	38.2	2.29	123.7
June	233.5	91.10	39.1	2.33	123.9
July	233.1	92.12	39.2	2.35	123.7
Tires and Tubes					
1939	54.2	$33.36	35.0	$0.96	
1957					
Apr.	71.1	103.46	40.1	2.58	
May	84.9	103.46	40.1	2.58	
June	78.2	107.23	41.4	2.59	
July	84.4	112.20	42.5	2.64	
Aug.	84.2	107.83	41.0	2.63	
Sept.	84.4	107.20	40.3	2 66	
Oct.	84.4	105 18	39.1	2.69	
Nov.	84.0	106.62	39.2	2.72	
Dec.	83.6	105.84	39.2	2.70	
1958					
Jan.	109.2	98.52	36.9	2.67	
Feb.	105.6	93.02	35.1	2.65	
Mar.	102.5	98.05	37.0	2.65	
Apr.	98.4	95.67	36.1	2.65	
May	96.3	99.48	37.4	2.66	
June	96.8	103.63	38.1	2.72	
July	96.7	106.59	38.9	2.74	
Rubber Footwear					
1939	14.8	$22.80	37.5	$0.61	
1957					
Apr.	17.5	70.64	38.6	1.83	
May	17.3	71.92	39.3	1.83	
June	17.4	72.29	39.5	1.83	
July	16.9	72.13	39.2	1.84	
Aug.	17.2	73.05	39.7	1.84	
Sept.	17.6	74.45	39.6	1.88	
Oct.	17.7	76.02	39.8	1.91	
Nov.	18.0	78.96	40.7	1.94	
Dec.	17.9	79.35	40.9	1.94	
1958					
Jan.	21.8	74.87	39.2	1.91	
Feb.	21.5	74.68	39.1	1.91	
Mar.	20.9	76.61	39.9	1.92	
Apr.	20.7	75.46	39.3	1.92	
May	20.6	75.85	39.3	1.93	
June	20.5	77.20	40.0	1.93	
July	20.1	75.25	39.4	1.91	
Other Rubber Products					
1939	51.9	$23.34	38.9	$0.61	
1957					
Apr.	102.7	79.60	40.2	1.98	
May	102.2	79.80	40.1	1.99	
June	101.2	81.81	40.7	2.01	
July	98.6	82.62	40.7	2.03	
Aug.	102.9	83.84	41.1	2.04	
Sept.	104.4	85.08	41.1	2.07	
Oct.	107.4	86.10	41.0	2.10	
Nov.	107.0	85.05	40.5	2.10	
Dec.	105.8	84.03	40.4	2.08	
1958					
Jan.	129.5	80.94	39.1	2.07	
Feb.	123.8	80.32	38.8	2.07	
Mar.	120.2	79.87	38.4	2.08	
Apr.	115.6	79.87	38.4	2.08	
May	113.6	80.29	38.6	2.08	
June	116.2	83.77	39.7	2.11	
July	116.3	83.53	39.4	2.12	

Source: BLS, United States Department of Labor.

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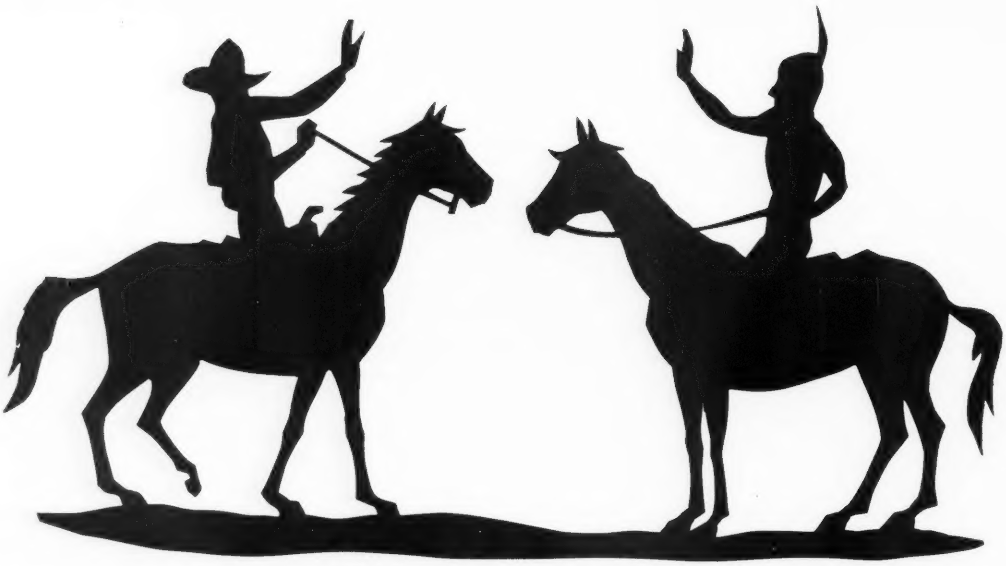


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